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METAL FINISHING

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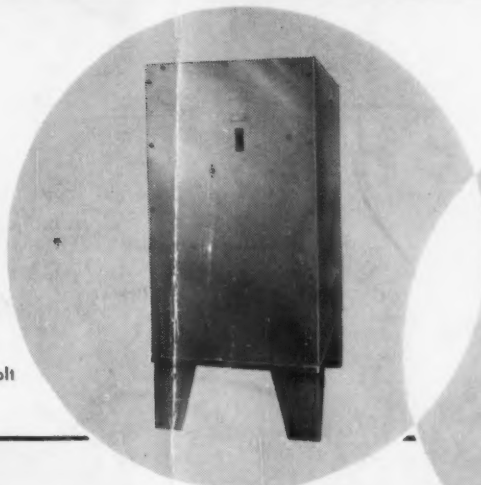

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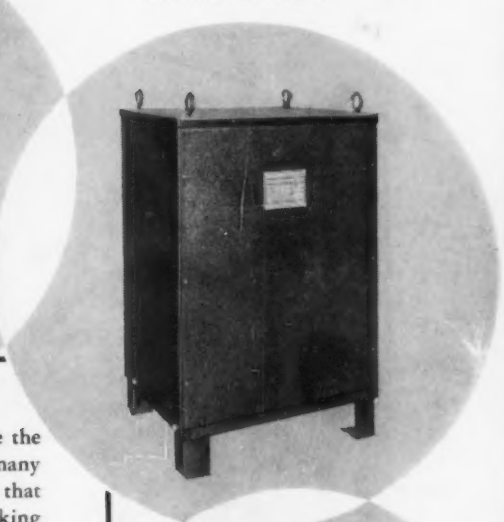

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METAL FINISHING

Founded as Metal Industry, January, 1903
by Palmer H. Langdon, 1868-1935

JANUARY, 1948 VOL. 46 • NUMBER 1

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424 S. Broadway, Los Angeles 13, Cal.
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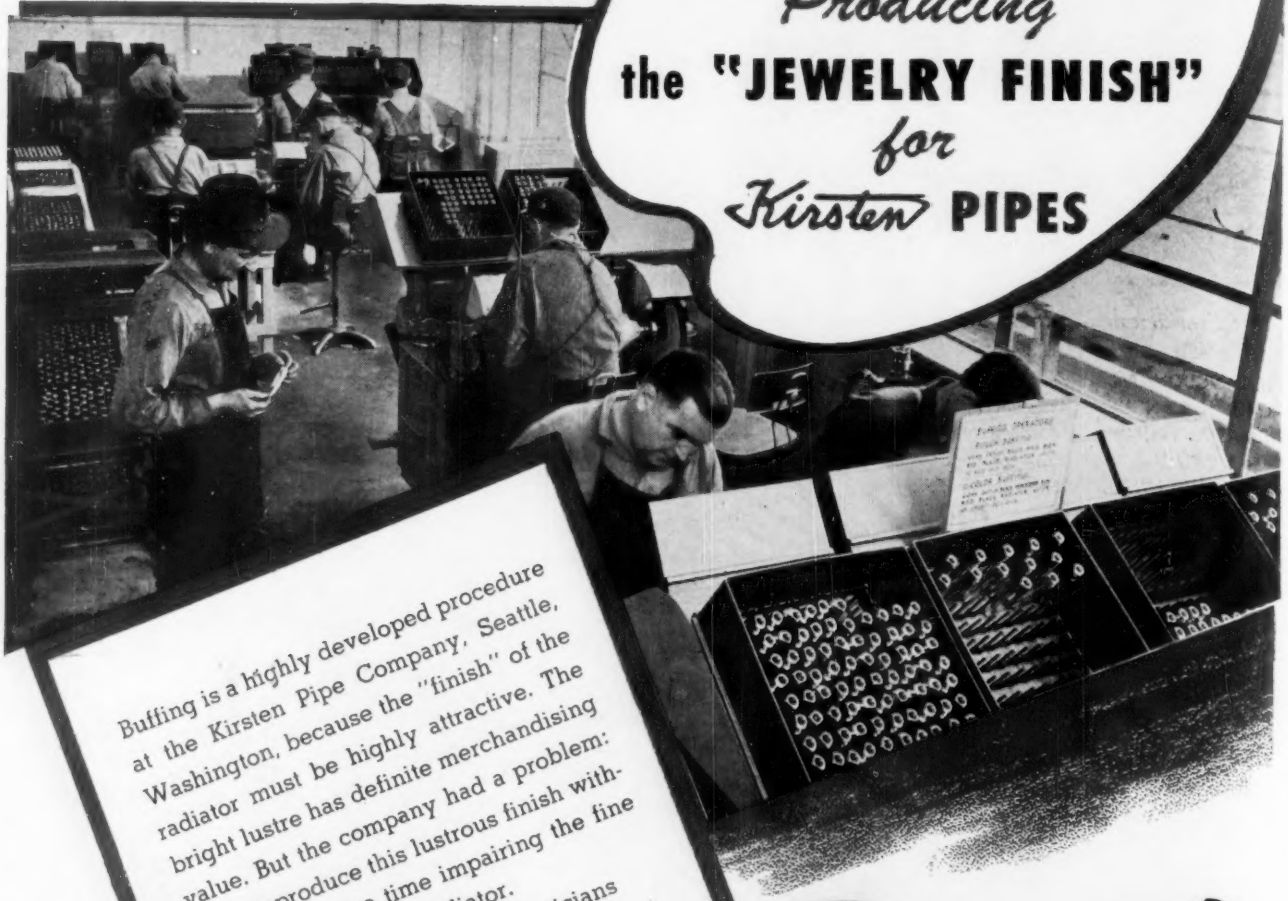
LEA METHOD···LEA COMPOUND

Producing the "JEWELRY FINISH" *for* Kirsten PIPES



Buffing is a highly developed procedure at the Kirsten Pipe Company, Seattle, Washington, because the "finish" of the radiator must be highly attractive. The bright lustre has definite merchandising value. But the company had a problem: how to produce this lustrous finish without at the same time impairing the fine design line of the radiator.

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METAL FINISHING

VOLUME 46 • NUMBER 1 • JANUARY 1948

Looking Ahead

It is comforting to note that the general feeling existing at the present time among the executives in the metal finishing field is one of optimism and bright hopes for the coming year. This same degree of optimism may not prevail throughout industry in general, and is probably accounted for by the fact that the swing toward a purchaser's market is forcing manufacturers to increase the quality and sales appeal of their products.

For some time now the sales groups have recognized the fact that the time has come when merchandise must be "sold" to the consumer, not just merely made available, and that one of the most potent factors involved is the quality and durability of the finishes used. Particularly is this true in the household appliance field, one of the largest in the metal finishing picture.

All this, of course, puts the finishing group "on the spot," and the anticipated activity for the coming year will be along the lines of improved materials and automatic equipment. Finishers are continually seeking more efficient methods and machines to offset the ever increasing labor costs, and equipment suppliers will be hard pressed to meet these demands in the face of steel shortages and the lack of sufficient trained personnel.

Generally speaking, there should be considerable relief in the still fairly tight supply of chemicals, notably cyanides, cadmium, and caustic soda. Construction of machinery and equipment will, however, depend to a large extent on the steel supply, with apparently very little change expected here over the situation which prevailed throughout 1947. Most of the suppliers have already expanded and strengthened their distribution set-ups to provide quicker deliveries and better technical service.

All things considered, the finishing field should continue to enjoy a healthy and prosperous period of activity for some time to come.

1947 Progress in Metal Finishing

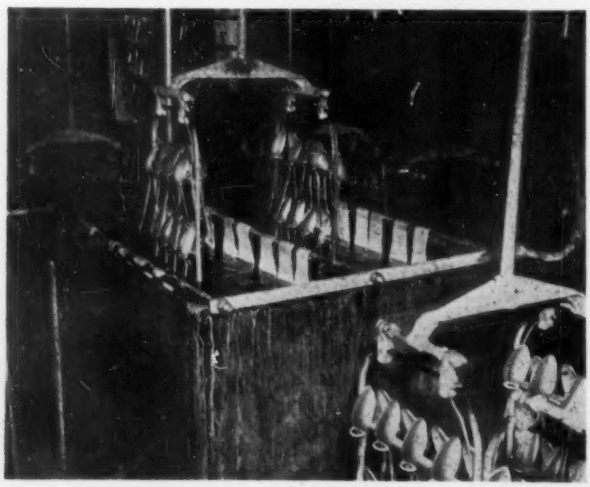
By Walter A. Raymond, *Engineering Editor*

Theoretical

INCREASED investigation and research into the theoretical and academic aspects of electrochemical processes for metal finishing was noticeable during 1947. This is no doubt due to the diversion of research personnel away from the problems of war production and re-conversion and towards the broader and fundamental issues requiring solution. Particularly noticeable was the decided increase in the number of papers on the theoretical phases of metal finishing that were given at the American Electroplaters Society National Convention and the Third International Conference on Electrodeposition the latter being held in London and attended by representatives of most countries.

The importance of cathode potential in alloy plating was investigated by Banerjee,[1] who found that Cu-Zn alloys of any composition could be deposited by control of Cu-Zn ratio in the bath plus control of cathodic potential.

Steer[2] discussed the mechanism of peeling and blistering of plated metals as investigated by metallographic methods. Three principle causes of exfoliation were determined: Pure stress, chemical or direct, and combinations of both. Van der Sommen[3] also reported on internal stresses in copper and the various factors involved, such as solution analysis, presence of other metallic impurities, and addition agents.



Electropolishing silver cutlery reduces finishing costs.

Six barrel capacity plating unit.

The influence of the base metal on the character of plated deposits was investigated by Piontelli,[4] who reported on the influence on rate of formation of crystallization centers, preferential deposition, and deposition potentials.

Kushner[5] brings out some interesting views on the affects of fluid pressures on the electroplating process, which should suggest new avenues of research.

A report on the porosity of various plated metallic coatings was made by the American Electroplaters Society[6] Research Committee. One interesting fact brought out by this work was that the porosity of chrome deposits first decreased to a minimum at about .00002-.000028", then increased again, due to the stress-relieving cracking. Data on other metals was also presented.

Polishing

Conventional methods of wheel polishing were improved by increased use of automatic equipment to affect economies and alleviate the shortage of skilled help. Development of mechanical applicators for applying compounds to wheels lessened non-productive

time of operators. Suspensions of abrasives in liquid carriers were utilized in spray type applicators. Patents [12, 13, 14, 15, 16, 17] were issued for several new types of abrasive wheels. Increased use of non-glue binders, with evidence of superiority for certain classes of work, was reported. The use of belt methods found wider acceptance, and many new items of equipment became available for utilizing this method of abrasive polishing.

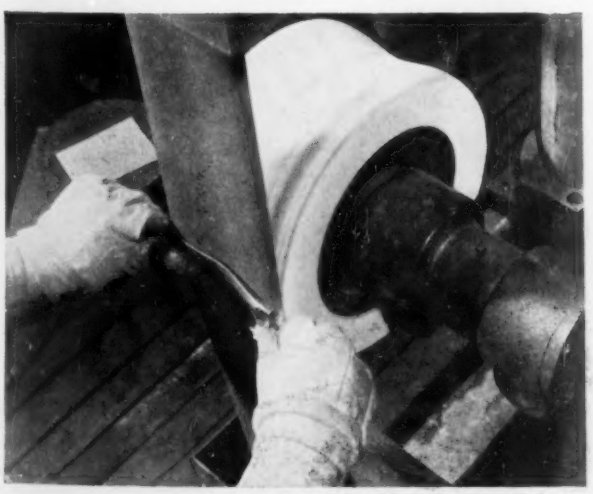
Electrolytic methods of surface preparation were the subject of widespread interest and development. Black[18] reviewed the electropolishing of magnesium and its alloys; a new technique for electropolishing silver was described by Gray,[19] and a patent issued to Eaton.[20] The use of fluosulfonic acid baths was investigated by Young and Hesse,[21] who found promising results on stainless and carbon steels, and nickel silvers. Jacquet[22] reported on the general utilization of electropolishing methods, and Decker, Krijff, and Plutt[23] investigated the method for carbon steels, zinc alloys, and lead alloys, with emphasis on the distortion in surface layers.

Halut[74] described the commercial application of electropolishing to produce a "superfinish" and reported on the increased wear resistance and resistance to fatigue type failures on electropolished ordnance parts.

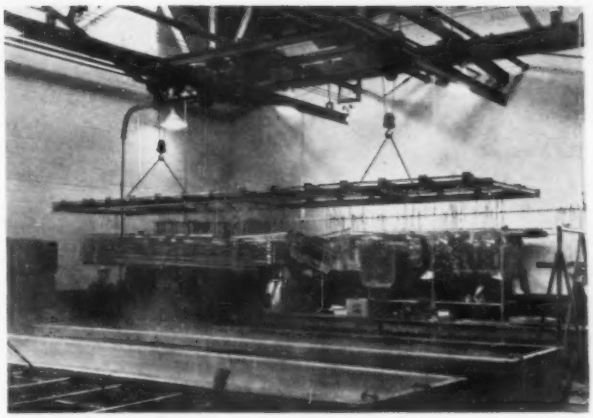
Cleaning and Pickling

A new method of abrasive blasting was developed by Potter,[7] which utilizes the propelling power of a burning gas to drive the abrasive particles. Bugley[8] was granted a patent for a sand blast nozzle having a diamond-impregnated inner surface to resist the cutting action.

Much attention has been paid to improvement of cleaners and detergents, with the development and use of wetting agents playing a large part in the stepped up efficiency and speed of modern prepared cleaners. Multiple-phase cleaners, comprising an unemulsified solvent and an emulsion type solvent were described by Ewing.[9] Nearly all large producers of cleaning materials announced new or improved emulsion type



Contour polishing with backstand equipment.



Large cleaning installation handles 2000 sq. ft. of surface per load.

cleaners, the value of which has been demonstrated by thorough plant usage.

A method for reclaiming spent pickle liquor was described in a report by the Office of Technical Services.[10] The method utilizes ethyl alcohol to precipitate the iron and has proven to be economical and efficient. Pickling inhibibtors were the subject of increased development, and several patents were issued on new compounds for decreasing attack of the metals being pickled.[11]

Increased use of electrolytic cleaning methods was very much in evidence, and the incorporation of an electro-cleaning step is now almost standard for all metals before plating.

Plating

ALLOYS

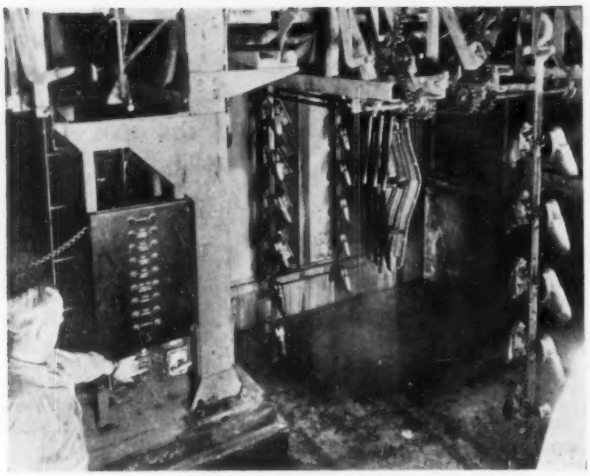
Considerable development was in evidence of the deposition of alloys from solution. Brenner[24] described a method for plating tungsten-iron-nickel-cobalt alloys. Piontelli[25] developed sulfamate baths for depositing nickel-cobalt, lead-tin, and zinc-cadmium alloys. A British patent was issued[26] for a method for copper-lead and silver-lead alloys, and another[27] for tin-copper alloys. In this country patents were issued for processes for plating nickel-zinc alloys[28] and molybdenum-cobalt alloys.[29]

MAGNESIUM

Plating on magnesium with zinc, nickel-tin, and silver and lead alloys was developed by Rogers and Boyd,[30] and a patent[31] was issued to Wagoner for depositing copper, zinc, cadmium, tin, silver, and gold on magnesium surfaces.

NICKEL

In the field of nickel plating, Gardam[32] investigated the role of organic sulfonates as brighteners in nickel solutions, and found that their brightening action was due to inclusion of the sulfonate on the cathode. A patent[33] was issued on the use of 2-phenyl ethylene sulfonic acid in a nickel solution. Another patent[34] for the use of sulfurized gelatin was issued to Hull and Hoffman. The practical application of heavy nickel coatings for industrial use was discussed by Wernick[35] and Roehl,[36] with details on properties, adhesion, etc.



Plating automotive parts automatically. View of one control station.

CHROME

Wider use of hard chrome plating was very much in evidence, both for tools and structural machine parts. Williams[37] reported on the increased life of cylinder bores when hard chrome plated, and outlined the correct procedure for direct plating on cast iron cylinders. A comprehensive report on the methods and results for tools, including milling cutters, arbors, taps, reamers, and thread gauges was made by Halvorsen.[38] The structure of bright chrome deposits was investigated by Dale,[39] who found network films, probably of hydrated chromic oxide, throughout the deposits. Refineries of these networks could be controlled by both temperature, sulfate ratio, and current density.

COPPER

Tope[40] reported on the control of Rochelle copper solutions, and found that pH was the important factor in eliminating blistering. The possibilities of alkenesulfonic acid baths were investigated by Faust, Agress, Combs, and Proell,[41] who found that under proper conditions fine-grained smooth deposits could be obtained under a very wide anode current density range, and that the plating exhibited the tendency to ignore the base metal structure, covering up certain surface defects. Two patents[42, 43] were issued for copper plating solutions; one consisting of a bath of soluble copper salts and an alkaylene polyamine plus citrates, tartrates or lactates; the other for a brightening addition of sulfurized sulfonated hydrocarbon in an acid copper bath.

CADMIUM

A new bright cadmium plating bath was announced which permitted higher current densities and improved covering power and brightness.[44] The throwing power, as affected by temperature, analysis, and current density, of cyanide cadmium baths was investigated by Breyers.[45]

OTHERS

A patent for an acid lead plating bath was issued to Gray,[46] which utilized anthraquinone sulfate and sulfite cellulose waste as addition agents. Bloom[47] patented a solution for electrodepositing fine grained selenium coatings from an aqueous bath of alkaline selenides, and Hogaboom[48] obtained a patent for an acid zinc solution of chloride and acetate.

Increased application of electroplated coatings on aluminum was apparent, with the details of the zincate dip being the subject of investigation for successful processing.[49]

Surface Treatments

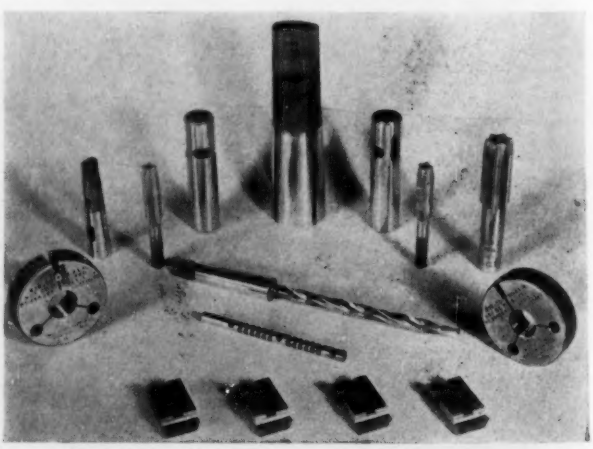
Chemical surface treatments other than electroplating also saw considerable activity in the past year. In many cases, these treatments were preliminary treatments given to impart special or modifying characteristics to the ultimate finishes, but in a number of instances these surface treatments were the only protection applied.

The use of dyed anodized finishes increased, with such articles as buttons, fountain pens, cosmetic containers, etc. being offered in a large assortment of colors with high sales appeal. Although the techniques of anodizing aluminum are now well known, the dyeing phase of the operation has come in for a larger amount of study. Rhael and Summers[53] reported on the methods used to control colors, as did Gill.[58]

Anodic treatments for magnesium were brought to a higher state of perfection, and dyed coatings on this metal were also brought into wider use. Besides the commoner methods now in current use,[54, 55, 56] a new process was patented by Waterman.[57]

Plating of metals on non-conductors was the subject of several investigations, with emphasis on practical production methods. Narcus[59] reported on a method for depositing copper films, and pointed out several advantages over silvering methods, including cost, thickness of deposit, and adhesion. A patent[60] was granted on this process. The plating of silver on glass for metal-to-glass seals was reported on by Freedman.[61, 62]

Protective treatment for cadmium plated articles which rendered the deposits passive were investigated and reported on by Halls.[63] The solution consisted of 13 gm/liter of Sodium Dichromate and .43 gms/liter of Sulfuric Acid. Holden[64] reviewed the various



Typical tools hard chrome plated to increase life.

methods for treating zinc surfaces and the affects on corrosion resistance and paint adhesion.

Korpium [65] obtained a patent for galvanizing or tinning aluminum from molten baths. A preliminary zinc immersion deposit from zincate solution, commonly used for electroplating pre-treatment, was an essential step in the process.

Black oxide finishes for steel and other methods such as copper and zinc were widely used, with several suppliers furnishing various compounds for the treatment. Increased use was made of oil or wax treatment of these oxide coatings to prolong the life and promote good appearance.

Testing

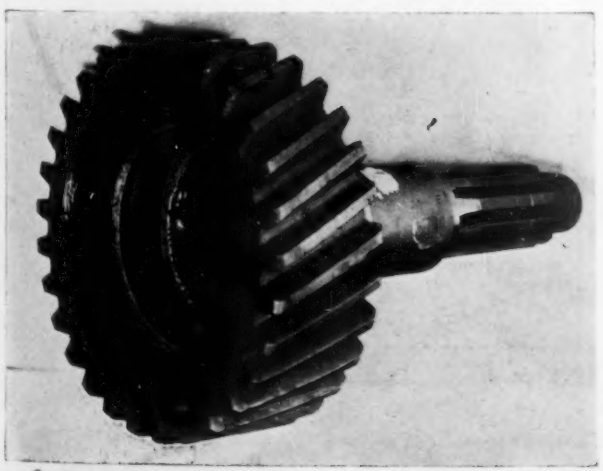
The attention of many investigators was directed to the evalution of the deposits in regard to hardness, heat resistance, porosity, protective value, and uniformity. Vernon[66] and Broomfield reported on the use of various optical instruments.

Mason and Cochran[67] investigated an electronic method of measuring the thickness of oxide coatings on aluminum alloys, and reported great accuracy of the method. A detailed study of the properties of nickel deposits was made by Roehl,[68] who found the greatest ductility of deposit as plated from a Watts bath at a pH of 4.5. Annealing improved this ductility, but over-annealing caused a decided loss in ductility.

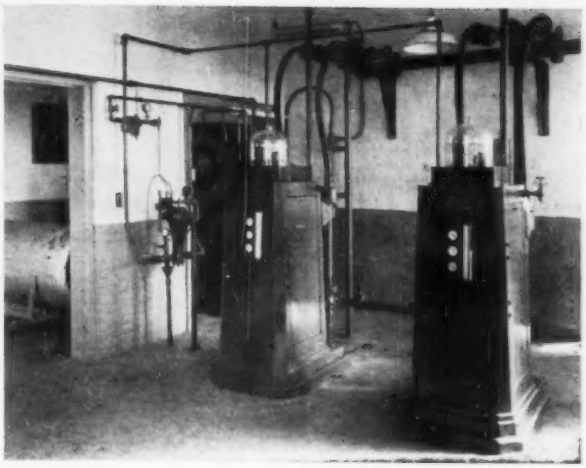
Several research projects sponsored by the AES are still investigating physical properties and methods of testing. Several improved methods of chemical analysis of solutions were developed for gold,[69] silver,[70] and free caustic and carbonates in cyanide baths.[71]

Equipment

The most important development in the equipment field was the brighter picture in regard to the delivery of most items. No outstanding or radical changes in design were made in most cases, although nearly all suppliers were incorporating minor improvements and controls. The trend towards semi-automatic and full automatic equipment continued, the ultimate being reached in the installation of the world's largest automatic plating plant in one of the large automotive plants.[72]



Transmission gear salvaged by plating with Nickel .020" thick.



Chlorinators used in treating cyanide wastes to avoid pollution of water supplies.

A new technique and equipment for "spot" or restricted area plating was developed by Canner, Twele, and Connor,[73] using solution velocities as high as 100 feet per second to promote rapid deposition of metals at very high current densities. This equipment might have considerable use in copper plating certain areas of parts to prevent carburizing.

General

The application of reverse current methods of electroplating created considerable interest, and further industrial use of the technique should develop rapidly.[50, 51] The principle is apparently applicable to many types of plating, and important advantages in speed and density of deposited metal are claimed.

Finishing plant engineering has been much more in evidence during the past year than ever before. Much attention was given to disposal of plating room wastes, and several of the larger concerns installed expensive and elaborate systems for neutralizing and treating their waste materials to lessen or eliminate stream pollution. This subject will become more important in the next few years, as most states have enacted, or are planning to enact legislation requiring treatment of industrial wastes, with the imposition of heavy fines on violators. The subject has been made the object of a large amount of research, including that by the American Electroplaters Society.[52]

In the rack coating field, many new materials were developed, outstanding among these being the "100% solids" types which permit the heavy coating of racks in a single dip, thus saving a good percentage of rack preparation lime. As yet, however, no material has been developed that will withstand prolonged vapor degreasing cycles.

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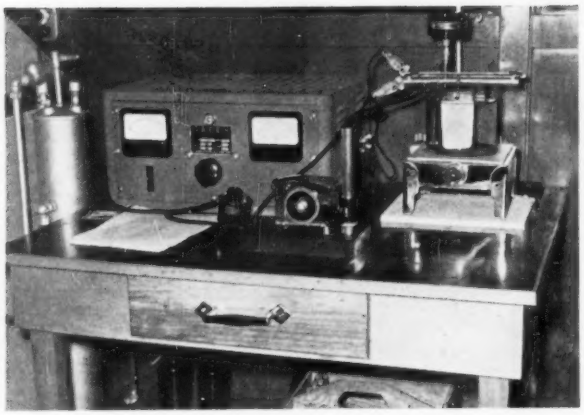

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ERRATA

In the article "Testing Alkaline Metal Cleaners" by A. Mankowich, which appeared in the December issue of METAL FINISHING, an error in the text was called to our attention by the author. Page 78, column 2, fifth line from the bottom should read as follows: "The spray pattern method gives a 'cleaning efficiency index' which is a measure of the area over which the residual soil has been spread. It is conceivable that widely differing weights of residual soil could could be spread over the same area, but all giving the same cleaning efficiency index."

The Cyanide Content

By J. B. Mohler and H. J. Sedusky, *Research Chemists*

In this paper the authors show how to make up various cyanide baths from data given in any formula. The calculations required in determining cyanide content are given and illustrations of each are listed; present-day meanings of the common terms in cyanide plating are also presented.

IN any business or profession it is necessary to learn the language of your means of living. A given word in the language may have a different meaning for various individuals. The word stock will suggest animals to a farmer and a means of finance to a business man.

To operate plating baths it is necessary to be conversant with many terms that have value for control purposes. Some of these terms are not strictly accurate, but if they express a quantity that is reproducible they may be used. A measuring device such as colorimetric pH is of value primarily because it is reproducible even though it may disagree by 0.5 pH unit from an electrometric measurement. The point is that it must be realized that these two methods must not be used interchangeably at face value.

In many cases a word such as alkalinity is used for more than one meaning. Alkaline may merely mean, as opposed to acid, or it may be an analytical term used to express all caustic that may be titrated above the pH as observed by the color change of an indicator.

There is no difficulty of definition of the cyanide content of plating baths providing definitions are varied to provide for every case. The reason for this variation from case to case is that definitions for control purposes must of necessity be based on analytical determinations.

Definitions

Well defined terms are used by the research chemist[1] to describe the chemical combinations that take place in cyanide solutions. These terms are necessary for this purpose but they are too cumbersome for plating control.

It is difficult to give general definitions that will cover all cases for free cyanide and total cyanide; yet, a plater knows what is meant if these terms are applied to a specific case. It is best to define the following terms as they are commonly used:

1. Alkali cyanide
2. Metal cyanide
3. Free cyanide
4. Total cyanide
5. Combined cyanide

Alkali cyanide is either sodium cyanide or potassium cyanide since all other cyanides used in practice are metal cyanides.

Metal cyanide is the cyanide compound of the metals gold, silver, copper, zinc or cadmium.

Free cyanide is the value obtained by direct titration in the cases of copper, silver and gold.

Total cyanide is the cyanide obtained by direct titration in the cases of zinc and cadmium.

Combined cyanide is the amount of cyanide obtained by calculation based on the assumption that a definite complex is formed. The assumed complexes are shown in Table No. 1.

TABLE No. 1

Bath	*Metal Cyanide*	*Complex Assumed*	*Analysis*
Cadmium	$Cd(CN)_2$	$Na_2Cd(CN)_4$	Free or total cyanide
Copper	CuCN	$Na_2Cu(CN)_3$	Free cyanide
Gold	AuCN	$K_2Au(CN)_3$	Free cyanide
Silver	AgCN	$K\ Ag(CN)_2$	Free cyanide
Zinc	$Zn(CN)_2$	$Na_2Zn(CN)_4$	Total cyanide

Silver Cyanide

If a silver cyanide solution is made up containing an excess of cyanide it will be found on analysis that the free cyanide corresponds with the calculated quantity.

Suppose it is desired to make up one liter of the following bath:

Ag CN	42 grams per liter
free KCN	40 grams per liter

The metal cyanide will consist of 42 grams of silver cyanide, which will react with potassium cyanide to form a solution according to the following equation:

$$\underset{42}{AgCN} + \underset{20.4}{KCN} = \underset{62.4}{K\ Ag(CN)_2}$$

Forty grams of potassium cyanide will be required

in excess to obtain 40 grams per liter of free potassium cyanide or 60.4 grams in all.

For the silver bath the terms free potassium cyanide and potassium cyanide are all that are required.

Analyses are not made for total potassium cyanide so that this term is not required.

If the same bath were made from silver nitrate and potassium cyanide an additional 20.4 grams of potassium cyanide would be required or:

Silver nitrate	53.3
Potassium cyanide	30.8

Copper Cyanide

Suppose it is desired to make one liter of the following copper cyanide bath:

CuCN	26 grams per liter
free NaCN	6 grams per liter

In this case one mol of copper cyanide will combine with two mols of sodium cyanide.

$$\underset{26}{CuCN} + \underset{28.4}{2NaCN} = \underset{54.4}{Na_2Cu(CN)_3}$$

To obtain 6 grams of free sodium cyanide 34.4 grams of sodium cyanide is required.

The metal cyanide required is 26 grams of copper cyanide.

The alkali cyanide required is 34.4 grams of sodium cyanide.

The free cyanide obtained by analysis is 6 grams as NaCN.

The total cyanide obtained by analysis is 48.6 grams as NaCN.

In the case of silver cyanide baths the free cyanide obtained by analysis corresponds with the amount calculated, but in the case of the high efficiency copper cyanide bath it is necessary to titrate the free cyanide at 3° to 5° centrgrade.[2] At room temperature a higher value is obtained showing that the free cyanide is an empirical value. This quantity however corresponds closely to the theoretical amount.

Brass

In the case of a brass bath the cyanide is determined by distillation of the total cyanide as HCN. Free cyanide is sometimes specified, and this is by definition rather than by direct analysis.

It is assumed that the combined cyanide includes the cyanide held by the complexes

$$Na_2Cu(CN)_3 \text{ and } Na_4Zn(CN)_4$$

Suppose it is desired to make the following bath:

CuCN	30 grams per liter
$Zn(CN)_2$	10 grams per liter
free NaCN	15 grams per liter

If the metals are added as the metal cyanides, CuCN and $Zn(CN)_2$, then the alkali cyanide required as sodium cyanide would be determined as follows:

Free NaCN	15.0
NaCN combined with CuCN = 30 x 1.09 =	32.7
NaCN combined with $Zn(CN)_2$ = 10 x .83 =	8.3
Sodium cyanide required	56.0

TABLE No. 2

	Free Cyanide	*Total Cyanide*	*Complex*
Silver	by titration		$K\ Ag(CN)_2$
Copper	by titration		$Na_2Cu(CN)_3$ (approximate)
Zinc		by titration	No assumption necessary
Cadmium		by titration	No assumption necessary[4]
Indium	by titration		No assumption necessary
Gold	by titration		No assumption necessary
Brass	by calculation	by distillation	$Na_2Cu(CN)_3$ $Na_2Cu(CN)_4$
Bronze	by titration		$Na_2Cu(CN)_3$

The total cyanide as sodium cyanide obtained by distillation would be:

Free NaCN		15.0
NaCN in $Na_2Cu(CN)_3$	30 x 1.64	49.2
NaCN in $Na_2Zn(CN)_4$	10 x 1.67	16.7
		80.9

The factors involved in this case are:

Metal cyanide as CuCN	30 grams
Metal cyanide as $Zn(CN)_2$	10 grams
Total NaCN	80.9
Free NaCN	15.0
Combined NaCN	65.9
Alkali cyanide NaCN	56.0

It is important to keep in mind that the total cyanide is a real quantity determined by a reliable analysis whereas the free and combined cyanide are present only by definition. The alkali cyanide is also a real quantity since it is the amount used to prepare the bath; but if copper carbonate were used in an equivalent amount in place of copper cyanide, then a greater quantity of sodium cyanide would have to be used to obtain the calculated free cyanide. In either case, however, the total cyanide would be the same.

Zinc Cyanide

Consider the following solution:

$Zn(CN)_2$	60 grams per liter
NaCN	22 grams per liter
Alkali cyanide as NaCN	22
NaCN in $Zn(CN)_2$ 60 x .83	49.8
Total NaCN	71.8
Zn in $Zn(CN)_2$ 60 x .56 =	33.6

(*Concluded on page* 67)

Fluid Mechanics: Forgotten Factor in Electroplating—Part II

By **Joseph B. Kushner**, *Metal Finishing Engineer, New York, N. Y.*

Surface Tension

AN IMPORTANT property of fluids that is of considerable interest to the plater is surface tension. Below the surface of a liquid the molecules comprising it are attracted equally in all directions by the surrounding molecules. At the surface of the liquid, however, the outer molecules are subject only to the attractive forces of the molecules on the inside (see Fig. 1), and consequently there is a tendency for the surface molecules to want to go inside because of the unequal pull. The outer layer of a liquid acts because of these forces, very crudely speaking, as an elastic membrane or "skin" which is always tending to contract or arrive at a minimum area. This fact gives the surface of a fluid physical and mechanical properties not possessed by the main body of the fluid. These properties are commonly lumped under the name Surface Tension.

Since a sphere contains a maximum volume of matter with a minimum surface area, the tendency is, where the effects of gravity are small, for liquids to assume a spherical shape. Indeed it is a fact if gravitational forces are counter balanced, liquids will assume perfectly spherical forms because of surface tension. Thus many years ago, the French physicist Plateau performed the following simple experiment which can be readily repeated: he suspended a quantity of olive oil in a mixture of alcohol and water that had the same density as the olive oil (see Fig. 2). The olive oil, not being miscible with the alcohol water mixture and the gravity forces being neutralized by buoyancy, formed itself, invariably, into a perfect sphere! He obtained in this way very large perfect spheres. While this is perhaps an uncommon example of the effects of surface tension, a more common one, well known to platers, is the semi spherical shape of a drop of water on a greasy piece of work!

If we wished to enlarge a liquid surface we would have to do work against the interior attractive forces that cause the surface to contract. The work necessary to increase the surface area by one sq. centimeter is called the *free surface energy* of the liquid. This surface energy is the mathematical equivalent of the *surface tension*, which is the force per centimeter opposing the increase, multiplied by the distance (one cm.) through which it has moved. The symbol for *surface tension* is the Greek letter gamma γ, and it can be imagined as a force acting at right angles to a line one centimeter in length in the surface.

Surface tension plays an extremely important role in electrodeposition. In the recent past many papers have been published discussing plating baths in which wetting agents (surface tension depressants) have been used and many have taken up methods for measuring surface tension in plating baths. Platers will often use "anti-pit" reagents or will be told that such and such a wetting agent will give good results in such and such a bath but why a wetting agent will do what it does and the actual significance of surface tension in electroplating is not often made clear.

Adhesion, Cohesion and Wetting

It is customary to speak of the molecular forces that hold a liquid together as *cohesive* forces and the molecular forces that keep unlike substances together as *adhesive* forces. Laymen sometimes think of cohesive forces being of greater magnitude than adhesive forces but this is not necessarily so as witness the common occurrence of a glued wooden joint breaking in the wood and not at the joint, when subjected to a tensile stress. Both adhesion and cohesion are manifestations of the same phenomenon, molecular attraction, which plays the prime role in surface tension and wetting.

Suppose we had a column of liquid one square cm. in cross section (see figure 3). If we attempted to pull the liquid apart along the plane xx_1 we would have to do work against the molecular attractive forces that hold the liquid together (cohesive forces) and such work could be called the *work of cohesion*. Consideration of the matter indicates that if we succeeded in pulling the liquid apart this way we would expose two new surfaces, each of these surfaces having the energy γ^L. Accordingly, by the law of conservation of energy, the *work of cohesion would be:*

$$\gamma^L + \gamma^L \text{ or}$$

$$W_a = 2\ \gamma^L \quad (1)$$

If we had two immiscible liquids A and B, resting

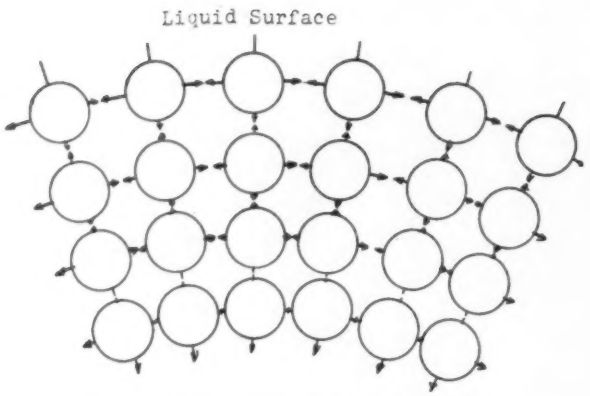


Fig. 1. Partial section through a liquid drop.

in the column, and we attempted to pull them apart at the interface, we would now have to overcome the molecular attractive forces of *adhesion*, the attraction of unlike molecules for each other. While the liquids are together the tension at the interface or mutual surface is γ_{AB}. If we pull the liquids apart then two distinct surfaces are formed, one with the surface energy γ_A and the other with the surface energy γ_B. This being so, we can say that the *work of adhesion* $W_a = \gamma_A + \gamma_B - \gamma_{AB}$ (2). This equation is know as the Dupre equation after its formulator a French Physicist. Equation 1 is a special form of the Dupre equation.

Platers are always concerned with the adhesion of the metal deposit to the cathode; actually they should be more concerned with the adhesion of the plating bath to the cathode, for what happens at this interface will not only effect the adhesion of the plate to the basis metal but the structure of the plate as well!

Solid substances have surface tension as well as fluids but unfortunately there is no way for truly measuring such tensions. Nevertheless they exist and since they do, Dupre's equation may be applied to the case of a liquid in contact with a solid. Thus if we had an electrolytye in contact with one sq. cm. of cathode surface (see figure 4) and attempted to pull them apart we would get the relationship:

$$(3) \quad W_a = \gamma_{LA} + \gamma_{SA} - \gamma_{SL}$$

Since the surface tension of the solid against air and against the liquid cannot be measured this equation cannot be used as it stands. To get around this difficulty the following fact may be used: If a drop of liquid such as mercury, rests on a glass plate, it assumes a shape sometimes as shown in figure 5b. This is an equilibrium position and the angle between the mercury surface and the glass plate is a definite fixed angle, the position of which is determined by the resolution of the three forces of surface tension which may be assumed to be acting as shown in the diagram. All liquids will assume some such characteristic fixed angle in contact with solids. This angle is known as the contact angle. Accordingly then, we have three forces in equilibrium as in 5a and $\gamma_{SA} = \gamma_{SL} + \gamma_{LA} \cos \theta$. Substituting back in equation 3 the value for the difference of the unknown surface tensions we get:

$$(4) \quad W_a = \gamma_{LA} (1 + \cos \theta)$$

This equation can now be used as the basis of a definition of *wetting*. *Wetting* can be said to occur if the angle of contact between the liquid and solid is less than 90°. If the angle is 0° then the adhesive forces between solid and liquid are as great as the cohesive forces of the liquid for itself, and we have perfect or complete wetting. If the angle were to be 180° there would be perfect non wetting. In practice this never occurs and one of the closest approaches to it is the case of mercury on a steel plate which gives an angle of 154°. Actually then, all solids are wet by all liquids and wetting is a relative term but we arbitrarily define wetting to take place if the angle of contact is less than 90°.

We can now define a wetting agent as a substance which when dissolved in a liquid reduces the surface tension of the liquid and/or increases the adhesion of the liquid to solids so that the angle of contact θ is made as small as possible.

Surface Tension in Metal Cleaning

The subject of detergency as it concerns metal cleaning prior to electroplating has been discussed many times in the past and it will not be discussed here. However, there are two points of interest that may be briefly mentioned in passing.

The first point is, what makes a good metal cleaner? The answer to this is: A good metal cleaner is a detergent that will bring about a complete displacement of the grease or soil in contact with the metal surface, by water, and will prevent the return to the metal surface of the displaced grease. In order to do this a detergent solution must have a *low surface tension* and it must have a low interfacical tension. This gives it penetrating power and more adhesion for the metal surface than that of the soil which it displaces. The second part of the requirement, prevention of re-

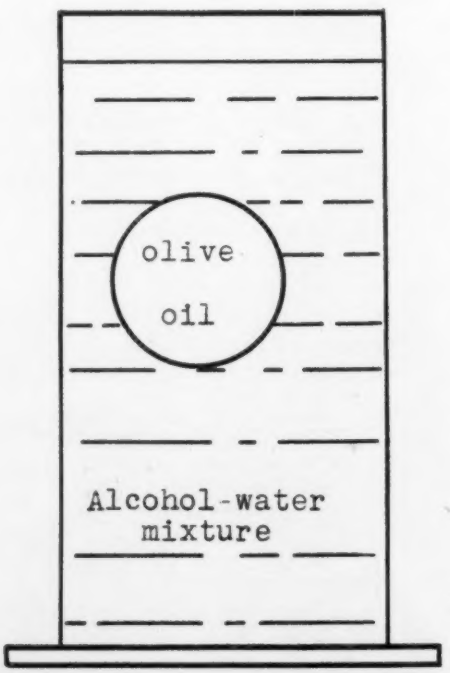


Fig. 2. Formation of a perfect sphere through surface tension.

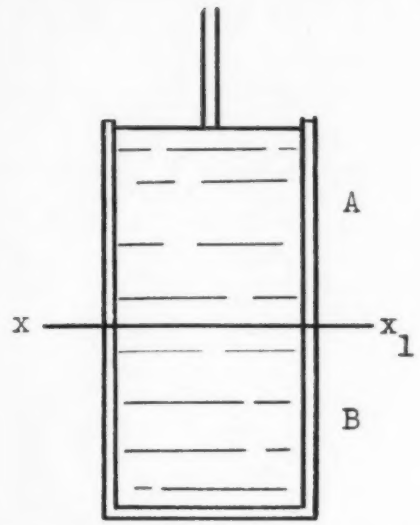


Fig. 3. Cohesion and adhesion between liquids.

precipitation on the metal surface, is usually taken care of by a second surface active agent in the detergent which has a greater affinity for the soil than it has for the metal. This literally puts a "bumper bar" around each soil particle and keeps it from settling back on the surface of the metal.

A second point of interest is the so called "scrubbing action" in electrocleaning. When work is cleaned electrochemically it is an accepted theory that the motion of the gas bubbles evolved, with the work either anodic or cathodic, acts as a scrubbing brush and helps clean the metal surface. Surface tension here plays a part not often considered.

There is a great deal of literature on blowing of bubbles of gas in a fluid from a definite sized opening but the writer has seen little or nothing on the generation of gas bubbles at electrodes. The well known relationship (5) $P=2\gamma/r$, where P is the excess pressure inside the bubble over that of the outside, r the radius of the bubble, and gamma the surface tension, seems to indicate that gas bubbles liberated at an electrode at a given depth in the plating solution cannot be smaller than a certain fixed size. A single molcule of hydrogen for example, if it were instantaneously converted into a bubble at the moment of liberation from a cathode, would call for an excess pressure of many thousands of atmospheres. This on the face of it, appears highly improbable and it would seem much more logical to suppose that the hydrogen molecules are evolved in clusters or groups which are instantaneously joined together at the moment of liberation to form a bubble of a definite fixed size and pressure so as to be in equilibrium with the forces producing it. There is a need for a mathematical analysis of this situation. In any case however, if we can assume the bubbles to be generated with a constant internal excess pressure, it is possible to prove very simply that a reduction of surface tension will bring about a considerable increase in the number of bubbles evolved.

This follows directly from (5) because of the following: The mass of hydrogen evolved in cleaning or plating without a wetting agent present, under fixed conditions of current efficiency is equal to $4/3\ \pi\ r^3\ n\ d$ where n is the number of bubbles, r the radius of the bubbles and d is the density of hydrogen. If we now add a wetting agent to the solution that cuts the surface tension in half, all other conditions remaining the same as before, then the new radius of the bubbles will be r/2, according to (5). Since the weight of hydrogen liberated according to Faraday's Law is the same as before and now equal to $4/3\ \pi\ (r/2)^3\ n,\ d,$ where n, is the new number of bubbles, we can equate both together and get $n, = 8n$. So theoretically we will be getting 8 times as many bubbles as we did before adding the wetting agent. This is a cube law that is followed. In other words, a reduction in surface tension to ½ the normal value will bring about an eight fold increase in bubbles, reduction to ⅓ normal will bring about a 27 fold increase and so on. It will be readily noted by a plater that gassing definitely does seem to increase on adding a wetting agent to a bath that did not have one before and in an electrocleaning bath it would seem that increasing the number of bubbles produced would materially improve the "scrubbing" action.

Surface Tension and Dragout

Dragout is a subject of interest to most platers and particularly to precious metal platers. A number of studies have been made of it in the past.

Dragout is the liquid that clings to a piece of work or plating rack that is removed from the bath. Outside of the mechanical factors of drainage time, shape and contour of the objects, there are two mechanical properties of the plating bath as a fluid, that effect drag out. These are surface tension and viscosity. Viscosity, which will be taken up in another paper, will not be discussed here, except to note that it effects the thickness of the dragout layer. This was proven in an indirect manner by Soderberg years ago when he showed that for minimum dragout, the work should be removed slowly from the plating solution and that there would be less dragout if the work were to be removed slowly from the solution and transferred to

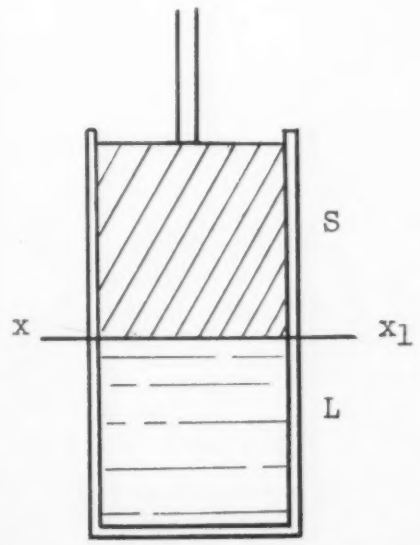


Fig. 4. Adhesion between a liquid and a solid.

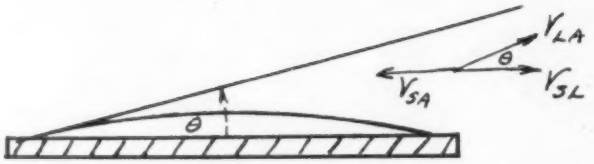


Fig. 5a. Almost perfect wetting. (Example: Water on a clean metal surface). Angle is acute, or less than 90°.

a rinse quickly rather than if it were removed rapidly and transferred slowly.

The relationship between dragout, viscosity and surface tension is undoubtedly an extremely complicated one that can only be resolved by dimensional analysis, if at all. Nevertheless, platers can take advantage of the following fact about surface tension, to bring about a reduction of dragout.

The weight of liquid that will fall from a capillary tip varies approximately with the surface tension of the liquid. Similarly, the weight of liquid that will drop off from an edge will vary very approximately in the same manner. This being so, it follows immediately that a reduction of surface tension will bring about a reduction in dragout, all other things being equal. Accordingly, if a gold or rhodium plater could reduce the surface tension of his plating solution with a suitable wetting agent that would have no adverse effect on the deposit, he might be able to reduce the volume of dragout, and thus his losses, by as much as one half, without slowing down removal or drainage time. This seems to be something worthwhile trying even though to date no experiments have been published in the literature in this connection.

Surface Tension and Pitting and Nodules

Pits and nodules in a plated metal deposit can be caused by plating around bits of matter that may migrate to the cathode by diffusion or electrophoresis, or matter that is produced directly at the cathode by precipitation of basic compounds. Pits can also be produced by gas bubbles adhering to the cathode or by a combination of these factors.

In the case of solid particles, if the adhesion between the cathode and the particles is high and that between the solution and the particles is low, the particles will stick to the cathode and form the nuclei of pits. If the reverse is true however, the particles will float off the cathode because of buoyancy or sink because of gravity. If the particles are very large they tend to fall off, if they are extremely small, they may be dislodged by the Brownian Movement. Investigators working in other fields have determined that particles in the size range of 2 to 3 microns are most likely

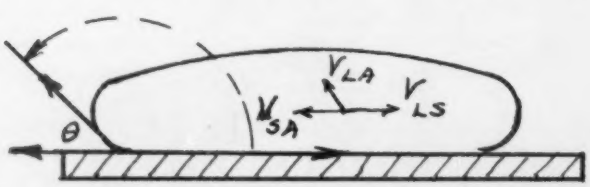


Fig. 5b. Extremely poor wetting. (Example: Mercury on a glass or steel plate). Angle is obtuse, or more than 90°.

to cling to solid walls because of adhesion. Since this means that particles from .00008" to .00012" in diameter are most likely to cling, it points the need for really good filtration of the plating bath! Another interesting point uncovered was that salt or anion concentration effects the clinging of particles. Increasing the anion cencentration increased the adhesion of small particles to solid walls. Applying this to the modern high speed concentrated plating bath, we see at once another good reason for better than average filtration of the bath!

In the case of silica particles it was found, however, that the metal or cation concentration effected the

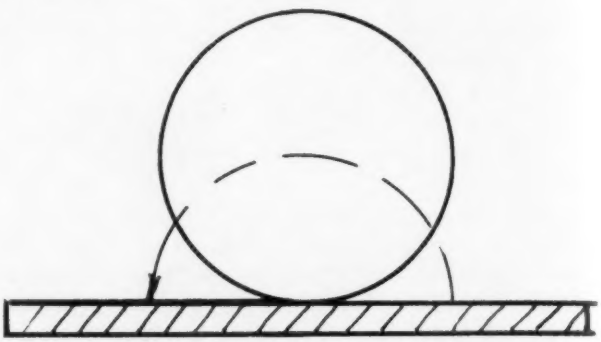


Fig. 5c. Perfect non-wetting. (Non-existant). Angle is 180°.

clinging to solid walls and that the effect was further enhanced by increasing valence of the cation. If this could be applied to plating baths it would seem that the presence of silica in a tin bath would be more damaging as regards nodules than in a silver bath, all other things being equal.

In the case of gas bubbles which are as much unwanted in plating as they are desired in electrocleaning, one or two observations may be of interest. A hydrogen bubble liberated at a cathode will in most cases tend to rise from the surface because of buoyancy but occasionally an entrapped air bubble or even a hydrogen bubble will stubbornly cling to the cathode. If not dislodged soon enough it can form the nucleus for a pit. On horizontal recessed surfaces facing the tank bottom, this difficulty will tend to be greater than on vertical and "open" horizontal surfaces. Agitation is a fairly certain method for dislodging these troublesome bubbles. Surface tension also plays its part. Adams gives in his definitive work on the physics of surfaces the expression γ_{LA} (1—cos θ) as the work required to detach 1 sq. cm. of solid surface from a bubble. This means that the addition of a suitable wetting agent which will reduce the surface tension and the contact angle to such a point as to make the expression a minimum, will greatly help in eliminating this type of sticking bubble. On the other hand if the surface tension is too low and the efficiency of the plating bath is low an excessive number of bubbles may be produced (see section on electrocleaning). There is also this consideration: Very small solid particles that are not easily wet by the plating bath will tend to gather on a bubble surface wherever they may contact it and these act to stabilize the bubble which will rise with the particles clinging to it only if the buoyancy can overcome the loading.

Where does a wetting agent come into this? A wetting agent or "anti-pit" agent if added to a bath may do one or both of the following things: (1) It may increase the wetting of the particle by the liquid and thus increase the adhesion forces between the liquid and the particle to such an extent as to overcome the adhesion forces between the particle and the solid wall (cathode) and (2) it may coat the particle with a surface "bumper" which prevents contact between the particle and the solid wall.

Surface Tension and Bright Plating

There are several theories of bright plating, but in general it has been shown in many ways that the bright surface is due to fine crystal structure of the deposit and a definite mass orientation of the crystals themselves. The fine crystal structure is produced by the presence in the plating bath of surface active substances which interfere with crystal growth. These substances interfere with the growth of crystal nuclei by possibly coating the individual nuclei as they are formed, causing resistance to addition growth and as a result most of the depositing metal goes to forming new nuclei instead of increasing the growth of old ones. Further it is quite possible that these surface active materials cause a definite orientation of crystal structure since it is known in general that areas on the same crystal do not all necessarily possess the same amount of surface activity. For example going to other fields for an analogy, an investigator on surface activity and catalysis found that while a trace of mercury on a clean copper surface reduced its adsorption power for all gases, it reduced this power for some gases very little and for others practically to the vanishing point! Thus the adsorption of hydrogen was reduced by 95% whereas the catalytic effect in hydrogenating ethylene was not even reduced by as much as ½ of 1%! Another investigator along a similar line found that different substances seek out different regions of a surface for their adsorption. These experiments seem to indicate that the mercury trace coated certain crystal faces of the copper more heavily than it did others, which it may not have coated at all.

It is quite possible, then, that a brightening agent will go to the interface and will deposit only on certain crystal facets and not on others, thus permitting growth only in certain directions and bringing about a definite orientation of the crystal surfaces. This also ties in very well with the commonly recognized fact that while some reagents will exert a brightening effect in all solutions, specific reagents are needed for a particular plating solution to give the brightest possible deposits. Thus, small amounts of cadmium have a high brightening effect on nickel (disregarding brittleness) whereas they have little or no effect on copper. Comprehensive experiments by Raub on bright nickel plating indicate that only certain classes of organic compounds have a brightening effect and of these only a few individual compounds produce the best results. One is reminded of the words of Professor Mathers in discussing addition agents: "Each solution is a law unto itself."

Since brightening of metal deposits is brought about by surface active materials regardless of whether they are colloidal or crystalline in nature, it is only natural to expect that surface tension reagents will effect these results. By weakening or increasing adhesions they can control to a certain extent the behaviour of the surface active substances that are present and that are the true brighteners. A great deal of research work remains to be done on surface tension in electroplating.

THE CYANIDE CONTENT

(*Concluded from page* 62)

$$\frac{\text{NaCN}}{\text{Zn}} \quad \frac{71.8}{33.6} = 2.13$$

The value 2.13 is called R and this ratio is sometimes specified as a control factor.[3]

In the case of a zinc bath the metal is sometimes added as oxide rather than cyanide so that the alkali cyanide is equal to the total cyanide.

Summary

In conclusion it is well to summarize the cyanide baths and the terms required for analysis and control as done in Table No. 2.

In the case of silver, copper and bronze[5] the free cyanide determined by titration corresponds closely to the calculated quantity.

In the case of zinc and cadmium the total cyanide is an exact determination and all the cyanide added as metal cyanide plus alkali cyanide will equal this quantity.

In the case of brass the cyanide added as metal cyanide plus alkali cyanide will equal the total cyanide obtained by analysis and the free cyanide is entirely by assumption.

In the case of gold and indium the limits on the free cyanide are so wide that it does not matter whether a complex is assumed or not.

References

1. M. R. Thompson, *Trans. Electrochem. Soc. 79* 417 (1941).
2. H. L. Benner and C. J. Wernlund, *Trans. Electrochem. Soc. 80* 355 (1941).
3. R. O. Hull, *Plating and Finishing Guidebook* pg. 141 (1944).
4. A method for free cyanide in a cadmium bath is given by G. Soderberg and L. R. Westbrook, *Trans. Electrochem. Soc. 80* 435 (1941).
5. Bronze is an alloy bath containing copper cyanide, free cyanide and sodium stannate.

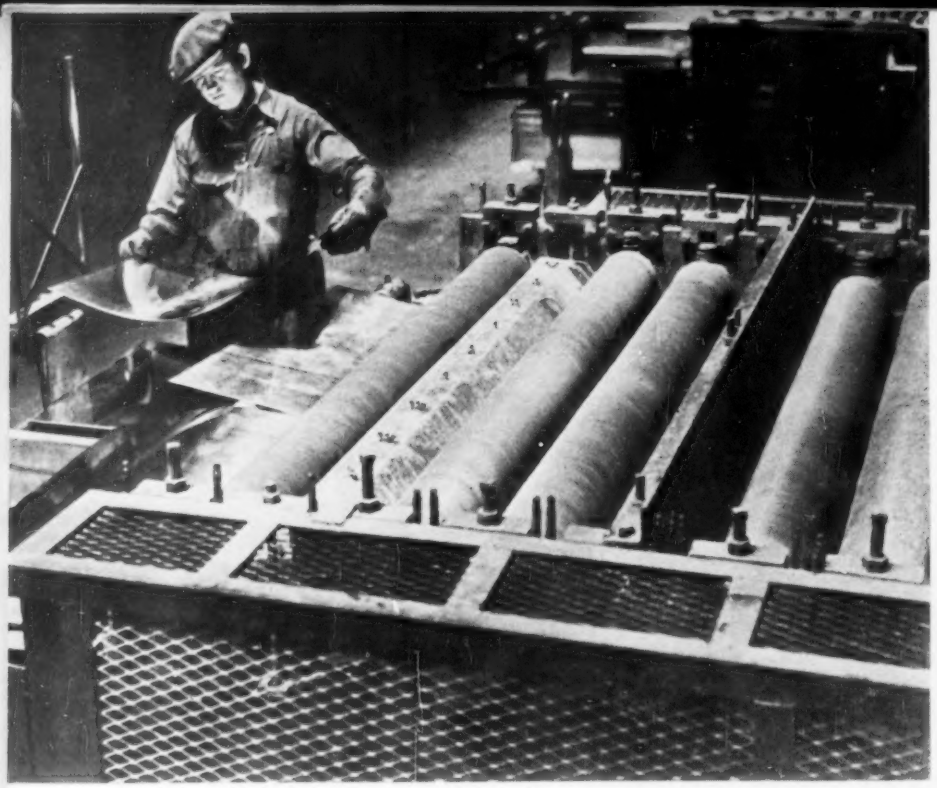


Figure 1. After the tinning operation in the hot dip process, sheets are polished to a mirror-like sheen by branner rolls, whereupon they are inspected.

(Courtesy Carnegie-Illinois Steel Corp.)

Tin Coatings on Metals

By **Frederick W. Bogert**, *New York, N. Y.*

TIN plate plays a leading role in the modern pattern of daily living. Americans open, discard and replace about 50 million steel-and-tin cans each day of the year. These containers package and protect thousands of food and non-food items at low consumer cost. Modern tin plate has a high degree of efficiency and its present rigid quality standards are the result of ceaseless chemical and metallurgical research.

History

Applying tin coatings to other metals is an ancient art. The Romans coated copper vessels with tin as long ago as 55 B.C. The Bohemians were dipping iron plate in molten tin while the Mongols were sweeping across Russia. The secrets of this early art even extended into Saxony but did not spread beyond these boundaries until the 17th century.

In 1670, Andrew Yarranton, an Englishman, learned enough about the process of "tinned over" iron plates to set up a small plant in Wales. The tin mines of Cornwall, abundant water power and the industrious Welsh population made the location ideal. Yarranton, however, was unsuccessful. Patent troubles forced him out of business.

A century later, Major John Hanburys took over Yarranton's old plant and introduced a new twist which was to start the Welsh tin plate industry on the path to the top. He substituted the hot rolling of plate for the old method of hammering plate out of bar iron. Production showed an immediate increase. The first milestone was passed.

Growth of the industry in Wales was rapid. Other important new developments appeared. The pickling machine, the annealing pot and a mechanical method of coating plates with tin came into use. In 1875, iron plates were replaced by steel and the industry was on its way to full growth.

Meanwhile, attempts to manufacture tin plate in America met with small success. Under the impetus of industrialization, America's demand for tin plate was growing. Canned food was then, as now, a basic requirement. However, tin plate supplies were imported from Wales and without a protective tariff to foster and encourage American tin plate manufacture, the Welsh had a virtual monopoly. This dependency upon imported tin plate was viewed with alarm by American business men and industrialists. It ended in 1890 with the passage of the McKinley Protective Tariff Act. Under the provisions of this act, a duty of 2.2 cents a pound was levied on imported tin plate.

Unshackled, American ingenuity and resources were concentrated on the production of top quality tin plate.

Tin plate combines the strength of steel with the corrosion resistance of tin as a protective covering. Of all the processes available for surface protection, tin is one of the most useful and economical. Tin is not only corrosion resistant but can be easily soldered and promotes better drawing and forming properties.

Most interest in the use of tin plate is in the container field—processed sanitary cans. General line cans, covering a large field of use ranging from some processed packs to dry packs, paint, oils and liquids, also consume large tonnages of tin plate. The closure market of crown caps, screw caps and other varieties accounts for additional consumption.

Advances

While tonnages consumed in these uses have increased by leaps and bounds, advances in processing have not lagged behind. Improvements in the physical chemistry of steel making, in methods of rolling and in the application of superior tin coatings have contributed their share. The advent of the wide strip mill and cold reduction method of rolling steel to extremely thin tin plate gauges changed many of the old ideas. The rolling properties have been greatly improved, deep drawing performances have been provided and the overall corrosive resistance of tin plate has been increased.

These higher standards for tin plate, in turn, led to new standards for sanitary packs and crown caps which necessitated improvements in tin coating methods. Tin coating practices were probed and an improved standard of quality and uniformity was evolved.

Early producers manufactured sheets which met the standards then in vogue but they relied on extra heavy tin coatings to supply extra corrosion resistance where extreme requirements called for it. Modern cold reduction methods provide steel with better properties for container manufacture. This improvement in the steel, coupled with better application of tin coatings, has increased the service life of sanitary cans in particular and all tin plate packaged products in general.

Metal Coating Properties

Tin as a metal for coating steel is unique. It provides in the most practical way, the solution to four main packaging problems:

1. Protection on the outside of the can from rusting in storage or in transit.
2. Protection on the inside of the can from corrosion by the contents.
3. It has the particularly favorable property, under most conditions, of maintaining the contents in their original state of clarity and natural flavor and free of contamination.
4. It permits necessary soldering, an effective closure, at extremely high production rates.

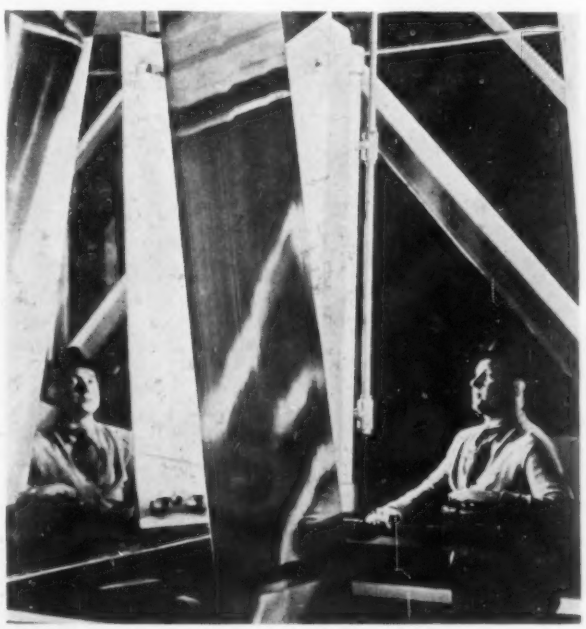
Hot Dip Tinning Process

Until the Japanese sneak attack on Pearl Harbor, tin was applied to steel by the hot dip process. In this operation, the plates are pickled in a hot solution of sulphuric acid and water to remove traces of oxide and dirt and to clean the surface for tinning. This is known as white pickling. The plates then enter tanks called boshes and are covered with acidulated water to exclude air and prevent the rusting of the steel. These boshes carry the plates to the tinning machine. Here the plates go into the feeder tank and are fed singly by automatic machines into one or more tinning lines.

As the first stage of the line, feed rolls conduct the plates through the flux, a solution of zinc chloride which must be constantly replaced. Next the plates are dipped into molten tin and then into a palm oil bath in which the tin coating is gradually cooled. Palm oil also prevents oxidation of the tin while the coating is solidifying.

Excess palm oil is removed from the plates by passage through a branner or an alkaline solution and a branner. A branner is composed of a series of felt, canvas or flannel rolls. Over these rolls, rye or wheat middlings, or other suitable material is continuously distributed. A very light film of oil is often left on the plates to prevent scratching or marring of the high lustre on the newly tinned surface.

One of the important steps in this hot dip method of processing tin plate is the rapid inspection of the sheets as they leave the tinning line. This chore is usually performed by women. Despite the large number of sheets examined daily for microscopic holes (as many as 10,000 are checked in one day by a "sorter"), few errors are caught by the checker at the end of the line. All sheets must be thoroughly covered with the protective tin.



(Courtesy U. S. Steel Corp.)

Figure 2. Electrolytically coated tin plate reflects the image of a tin plate inspector as it emerges from the plating and melting process.

When the Japanese overran the Malay Peninsula and the Netherlands East Indies, they seized practically all the sources of pig tin in the world. Reserve stock-piles had been built up and a thin stream of Bolivian tin trickled into the country but they were not enough. Tin plate coated by the hot dip process consisted of about 98.5% steel and 1.5% tin. America needed a more economical method of tin plating to conserve the supply.

For some years, research on a new process called electrolytic tinning had been under way. A considerable saving of tin could be gained by use of this innovation. It gave the plate a thorough, protective coating yet it cut the amount of tin used in plating by two-thirds. Now tin plate contains only about .5% tin. Many manufacturers were reluctant to reconvert their lines until the necessity arose.

Pearl Harbor provided that necessity. The tin plate industry immediately started to build enough electrolytic lines to cut tin consumption. Restrictive measures on cans and closures were in effect. Tin mill products were confined to essential needs to save both tin and steel for the war effort. Electrolytic tinning became a sound and established practice born of necessity.

Electrolytic Tinning

Introduction of electrolytic tin plate for food containers was gradual. Research organizations of the can industry guided the steel industry as indications of the requirements were obtained from extensive research studies. Liasion between can manufacturers and tin plate makers ironed out many troublesome problems.

The earliest commercial electrolytic tin plate was produced by electrodeposition from a sulphonic acid electrolyte. Since that time, two other types have come into usage. One of these employs either a sodium or potassium stannate as the electrolyte and is called the *alkaline process.* The other differs distinctly from the previous pair and uses a commercial electrolyte known as the *halogen process.*

Procedures

Regardless of the process used, the sequence for tinning plate electrolytically consists of a certain number of consecutive steps. In order these are: Cleaning, pickling, electrolytic tinning, rinsing, melting, quenching, chemical treating, drying, applying film oil, shearing, inspecting and packaging for shipment.

Steel intended for tin plating arrives at the tin mill in coils which are fed through electrolytic lines like newsprint through a modern press. On the entering end of the line, double coil holders allow the coil ends to be welded into one continuous strip. This eliminates stoppage of the line. Take-up towers or looping pits permit a brief delay for the welding operation.

The strip is first cleaned by immersion in a hot alkaline bath. Then it enters a long pickling tank for the removal of scale and discoloration. After another cleansing and drying operation, it enters the plating bath. In this bath, the strip is made the cathode and by direct electric current, tin is deposited on the cathode from the anode or plates of pig tin suspended in the bath. Then the electrolyte is washed off the strip and the strip is dried.

At this point, the tin coating is in a porous, matte condition. By passing the strip through a vertical chamber at a temperature above the melting point of tin, this coating is returned to a molten state. This reflowing of the tin gives the strip a bright, silvery hue. The strip is then immediately quenched to cool and solidify the bright, lustrous coating. To prevent discoloration and aid lacquer adhesion, a chemical treat-

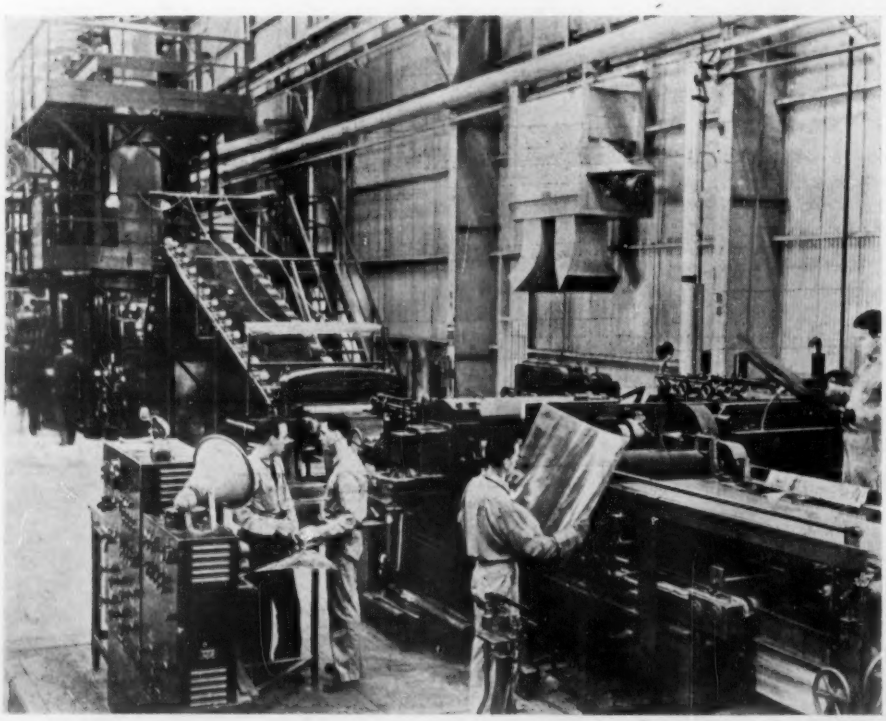


Figure 3. The delivery end of an electrolytic tin plate line. Frequent examination of sheets are made by spot checking as they roll off the line.

(Courtesy U. S. Steel Corp.)

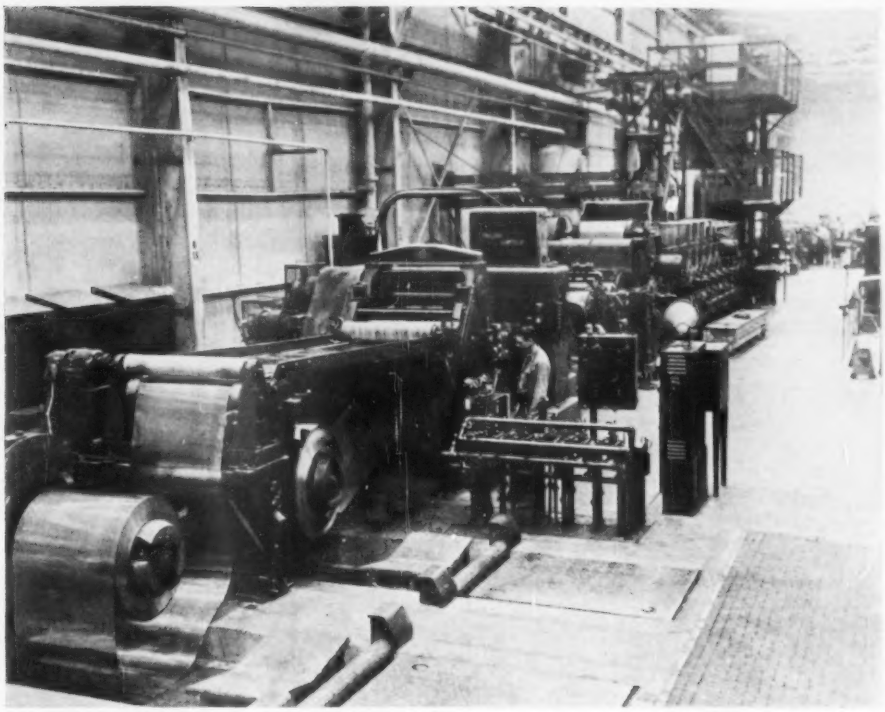


Figure 4. The entry end of an electrolytic tin plate line. Note the uncoilers and seam welders which join the strips together for continuous tinning operation.

ment is applied by dipping the strip in a prepared solution. After another drying operation, the strip is oiled by one of several methods: branner oiling, emulsion oiling or electrostatic oiling.

At some tin mills, the strip is sheared into sheets as it leaves the coating line. At others, it is re-coiled before the shearing is done. Defective and off weight plates are discarded while the cutting takes place, thus eliminating the hand sorting used in the hot dip process. The plates are automatically counted and placed upon wooden skids in bundles of 1120 sheets. Wrapped in paper, the tin plate is banded and stacked for shipment.

Conclusion

Until the advent of electrolytic tin plate, improvements in tinning practice had been gradual but progressive. Most of these had been in the rolling and making of the steel plate base. However, indications point to a refinement of all these new features and the principal development which forecasts expansion is the electrolytic process.

Many products that formerly used lacquered steel plate will probably change to electrolytic tin plate. This new process increases the natural life of the metal and provides a better and more attractive base for lacquering. Experience, gained to date with the use of electrolytic plate for food packing, presages an even wider use in this field.

In the future as in the past, the tin plate industry will keep pace with the can manufacturer for each is dependent upon the other.

Fig. 1. Stainless steel widely used for food handling equipment.

Fabricating and Finishing Stainless Steel—Part I

By Arthur P. Schulze, *Lakewood 7, Ohio*

In this series of papers, the complete field of stainless steel finishing is reviewed in detail. Part I covers the properties of stainless steel and complete cleaning techniques, other than pickling.—Ed.

HOW stainless steel has ascended to a position of major importance in the economic scheme of things comprises a sterling success saga, constituting one of the most startling, scintillating and significant chapters in the annals of modern metallurgy. Recounting this industrial romance, which has been related in technical literature elsewhere on numerous occasions, is beyond the scope of this article, the first in a series.

Our prime purpose here, instead, is to rivet attention on some of the more important operations involved in stainless steel fabrication, carefully examining various troublesome problems frequently encountered in this connection, particularly with regard to the dual aspects of cleaning and finishing. Yet certain development highlights, current trends and certain metallurgical considerations merit mention, admittedly brief because of space limitations, before proceeding with a full-scale analytical discussion of the subject at hand.

First introduced but little more than a quarter-century back, stainless steel soon demonstrated itself as one outstandingly successful solution to a diverse range of problem-applications where high resistance to corrosive attack, resistance to oxidation and scaling at high temperatures,[4] or its superior strength and physical properties were found either absolutely essential or highly desirable.[1]

It is this triple combination of unique qualities which since has expanded the uses of stainless steel into a near-endless and still ever-lengthening list of applications.[5] As a result, virtually every basic branch of modern industry has advantageously utilized these and other important characteristics of this amazing alloy to reduce costs, improve quality and increase service efficiency of products by the thousands.[6]

In fact, there are scarcely few industries that can be named where stainless steel is not employed in important product applications. Take aircraft, for example. Ailerons, air heaters, bomb racks, cable fittings and condensers are a few essential aeronautical applications. Or consider the chemical and process industries. Here, over 33 different types of equipment are fabricated from stainless steel. Still other examples are the milk products, food canning and meat packing industries where, altogether, stainless steel applications comprise over 83 different types of processing and handling equipment units. And many, many more examples from the automotive, marine, petroleum, paper and pulp, transportation and textile industries could be cited if space limitation would permit.[1]

Today, after slightly more than three decades of continuous development marked by such steadily-increased demand and constantly-widened acceptance,[4] stainless steel production stands at an all-time record

high. Output had in the neighborhood of 700,000 ingot tons in 1946, a volume considered but 50% of the nation's annual capacity anticipated upon completion of the industry-wide expansion program by 1948 or 1949. And meantime, should technology devise methods that would give a higher yield, total production of stainless steel could well reach a predicted 2,500,000 ingot tons a decade hence.[2]

Yes, the future of stainless is "mirror-bright," indeed. With such a good start having been made in getting this alloy accepted by the oil refining, paper manufacturing, and electrical appliance industries, one eminent interpretive reporter of the commercial scene comments, the 25-to-30 companies presently producing stainless steel are exploring new fields.[2]

Says this authoritative business observer:[2]

"A full-scale invasion can be expected into those fields where complete coverage has not as yet been attained. These fields include textiles, hospital and surgical utensils and instruments, railroad passenger and freight cars, and buses and trucks. Wider use of stainless in the passenger car field is anticipated by the steel industry.

"In the cooking utensil field alone some producers foresee an annual market of 40,000 to 50,000 tons. Such utensils are already being turned out in solid stainless or clad (sandwich) stainless which calls for a layer of soft steel between the inner and outer coats of stainless. In still another stainless, copper is applied to the heating surface for a better diffusion of heat.

"Because of the initial sales resistance, due to cost, and because of the care with which producers guard the reputation of their product, the selling job has developed into a specialized art. A customer would experience difficulty in placing an order for any sizable amount of stainless without first giving the producer complete details as to the use to which he expected to put it. It is because of past sad experiences of customers using the wrong type of stainless that practically all of the larger producers have added metallurgists to their field forces to advise potential customers."[2]

In this conclusion we have another, current confirmation of one major stainless producer's observation that because the development of stainless steels has been so remarkably rapid across the past two decades, many users adopted them without a clear-cut understanding of their major characteristics.[7] That is one reason why, then, a thorough working knowledge of stainless steels' physical properties is so essential to those operating executives responsible for fabricating and finishing these alloys.

Applications for ferrous metals in modern industry require many different properties or combinations of properties in the materials. For example, one application may call for high corrosion resistance and only ordinary physical properties while another may require high physical properties and high resistance to heat. Still another application may demand special fabricating qualities.

No one single metal, obviously, can meet all possible conditions. To answer these diverse needs a wide range of types of stainless steels has been developed, each one to emphasize or minimize certain characteristics of the metal to make it more perfectly suited for some particular or special class of service.[1]

So the popular phrase "stainless steel," therefore, does not apply strictly to a single, particular steel alloy. Rather, as is now generally known, it is the term most commonly employed to identify these specific alloys, which are available in many different analyses to meet a broad range of requirements.[8] For convenience, stainless steels can be divided into two main classes, namely:

(1) The straight chromium, or iron chromium steels, whose principal alloying element is chromium alone, and to which type numbers in the 400 series have been assigned.

(2) The chromium-nickel alloys, which contain as their chief alloying elements a combination of chromium and nickel in appreciable amounts. Of these, which have been given type numbers in the 300 series, the 18-8 types (approximately 18% chromium and 8% nickel) are the most commonly used.

Class I, the first stainless steels to be developed, are martensitic or ferritic at room temperature. Class II, later created to overcome some of the objections encountered in the use of the straight chromium family, contain sufficient nickel to be austenitic at room temperature.[6,9]

Variations of the basic 18-8 analysis have been produced by the addition of supplementary alloying elements . . . molybdenum, titanium, columbium and silicon, for example, among others . . . to develop certain specific properties of qualities, such as higher corrosion-resistance, stability at high temperatures, resistance to scaling, improved machinability, etc.[6]

Generally speaking, the chrome-nickel stainless steels are better known for their corrosion-resistance properties than the straight chromium types. Yet there are numerous instances, however, where applications of the two groups well might overlap because of the high resistance to corrosion of both types. That is why, in selecting a stainless steel for any particular application, careful consideration must be focused on all factors of fabrication, installation, operating conditions, and maintenance to assure optimum economical benefits.[10]

Based on their chemical composition and response to heat treatment, stainless steels may also be classified into three divisions: (1) straight chromium, hardenable grades; (2) straight chromium, non-hardenable grades; (3) chromium-nickel, non-hardenable grades.

Readily responding to heat treatment much the same as plain carbon and low alloy steels, Group No. 1 can be hardened and tempered to provide a wide range of properties. All grades are strongly magnetic; some may discolor superficially under certain conditions. Since, when hardened, their crystalline structure is composed principally of the microconstituent martensite, they are metallurgically known, and commonly referred to, as "martensitic" stainless steels.[5,11]

The straight chromium, non-hardenable grades (Group No. 2) do not harden to any appreciable extent when quenched from high temperatures. Also

strongly magnetic, they are, in general, more corrosion resistant than the first group. Upon annealing, their crystalline structure is primarily composed of the micro-constituent alpha ferrite, and hence are usually called "ferritic" stainless steels.

Except for surface hardening, chromium-nickel alloys making up Group No. 3 are non-hardenable through heat treatment but can be appreciably hardened to varying degrees by cold-working. Non-magnetic unless severely cold-worked, they are more corrosion resistant than either of the other two groups. Metallurgically, they are termed "austenitic" because their structure, when annealed, consists primarily of the micro-constituent austenite.[5, 11]

While stainless steels incorporate properties which make them different in numerous ways from other steels and metals, it is these very differences which account for the unusual adaptability of these alloys to meet a diverse range of uses where other steels would be unsuitable or unsatisfactory. Obviously, when it comes to selecting a type of stainless steel to do a particular job and also in the various processes of working it into the finished product, these properties must first be carefully considered and weighed.[11]

Because the stainless steels are so fundamentally different in physical properties and have special characteristics which distinguish these alloys from other metals, modifications of technique and practice are oftimes required in fabricating and finishing them. Yet, just as stainless steel development has progressed by leaps and bounds, so too, similarly substantial strides have marked the continual refinement and improvement of methods to simplify and speed-up fabrication and finishing.

Standard procedures have been developed in many cases which, because of the highly satisfactory results produced, have in such instances become well-established routines.[7] Especially does this hold true with respect to cleaning, pickling and mechanical finishing operations.

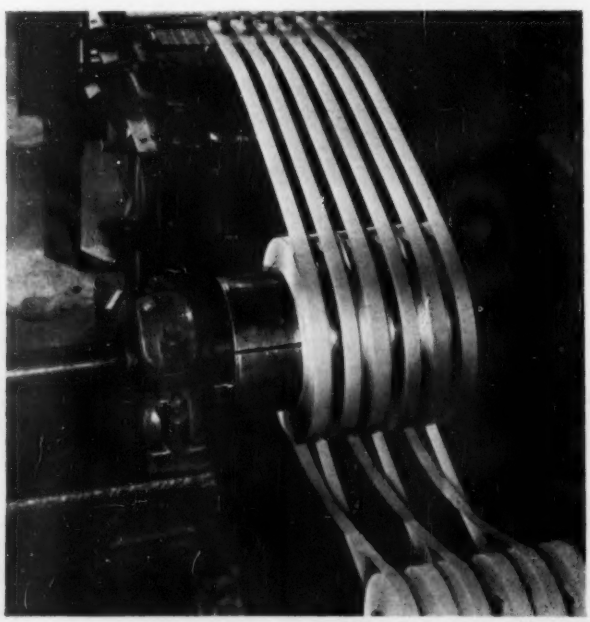


Fig. 2. Coiling stainless steel with protective paper strip to preserve mill finish.

A few of the more important problems and incidental operational factors usually encountered along these lines, together with methods and materials employed in various plants and shops for handling these particular processing operations, are comprehensively yet concisely reviewed in the following condensed information, which is presented in brief, digest form to conserve space and expedite quick reading.

At the very outset, it should be remembered that since the type of stainless steel in fabrication, its condition, production cycle followed, processing equipment used and other inter-related individual factors vary from one plant to another, the recommendations and suggestions advanced hereafter will, invariably, be subject to modification so as to adapt them to best meet particular requirements in any given instance. Thus, while necessarily general in scope, a conscientious attempt has been made to put the discussion on as specific a basis as possible. So it is hoped that this information will prove of timely interest and constructive value to all those metal finishing executives who may not be fully familiar with the various practices and procedures utilized in the process-cleaning and fabrication-finishing operations under discussion.

Removal of Drawing Lubricants Prior to Annealing

Removal of drawing lubricants is vitally essential before any annealing[7] or pickling operation.[9] Surface of the work must be thoroughly free from any trace of grease, oil or dirt, or pigment or solid matter from the lubricant.[3] If these deposits are left on the surfaces during the annealing process, they are burned in the surface or may cause carburization, and subsequqent pickling becomes difficult, usually resulting in a spotted shady surface.[9]

Charred organic matter will carburize the surface nonuniformly, resulting in its reduced corrosion resistance. Carburized areas, moreover, may be leached out in subsequent pickling, thereby leaving pitted and roughened portions.[12] On the other hand, thorough removal of foreign substances leaves a clean metallic surface which oxidizes uniformly during heat treatments and is, therefore, most favorable for uniform pickling results.[7]

Plant experience in numerous instances, however, indicates that effective degreasing is often a case of "easier said than done," since two operating conditions tend to complicate the problem and increase its severity, making this one of the toughest of all metal-cleaning problems to solve.

One is the fact that while chromium steels, as a group, possess high ductility when in comparatively soft condition, heavy-bodied lubricants are generally employed for severe drawing due to the high yield point and rapid work-hardening of the metal.[12] Sulphurized oils of heavy consistency, lard oil and sulphur, white lead and linseed oil, and similar mixtures with great adhesive properties, while they stand up under the high temperatures that may be encountered,[9] are, by the very same token, often exceedingly

difficult to remove by ordinary methods, thereby posing difficult cleaning problems.[12]

Nor can the factor of time be overlooked, particularly when it is realized that deep-drawn parts . . . . those made from the 18-8 group especially, for example . . . . are highly susceptible in winter weather to cracking, due to stress release or season cracking, within a short period following forming if allowed to stand around without application of heat.[6] But in any case, however, the degreasing cycle cannot be unduly prolonged or too greatly extended without causing trouble.[12]

If the part produced requires a second draw or additional operations, it is advisable to thoroughly remove the drawing compound and to anneal the work.[3] Where more draw is required than can be accomplished without re-annealing, all lubricating compound should be removed before reannealing as otherwise it may affect the surface of the article.[10]

Cleaning of drawn parts depends on the type of lubricant used. Oil-base compounds are usually best removed by soaking or washing with various industrial solvents, followed invariably by cleaning with alkali solutions. Where soap lubricants are used, the adherent film frequently may be removed either with plain boiling water or commercial cleansing agents without resorting to the use of kerosene.[3, 7]

In connection with water-soluble drawing compounds, however, one authority points out that unless past experience definitely indicates that solutions of the compounds emulsify the oil or grease, precautions should be taken in their use as in many instances an oil film forms on the surface of bath and recontaminates the metal surface when the work being cleaned is removed from the bath.[9]

Average practice in most shops and plants thus points up the fact that, in the case of oil lubricants, particularly those of heavy body, alkaline cleaning alone is not completely effective since it fails to "break-down" or dissolve tough-to-remove, extremely tenaciously adherent forming lubricant films. For that reason, a two-step operational technique is most generally recommended: pre-cleaning by emulsion-type degreasing, followed by still-tank alkaline cleaning. A typical degreasing-cleaning cycle of this category that has proved successful in several instances, recommended by one prominent supplier of specialized detergents who has centered considerable study and research on this particular problem, consists of the following four-step sequence:[12]

1.—*Precleaning:* Immerse parts for 1-2 minutes in solution of proprietary emulsion cleaner, made up in the proportion of 1 part material to 1 part degreasing solvent.

2.—*Spray Rinse:* With cold water.

3.—*Alkaline Cleaning:* Submerse work for 5-10 minutes in solution of recommended alkaline detergent, 4-6 oz. per gal., 180° F., minimum temperature. (Electrocleaning is frequently suggested in place of this still-tank degreasing since the electrolytic method accelerates the removal of grease, oil, etc., considerably.)

4.—*Final Rinse:* In clean, hot water.

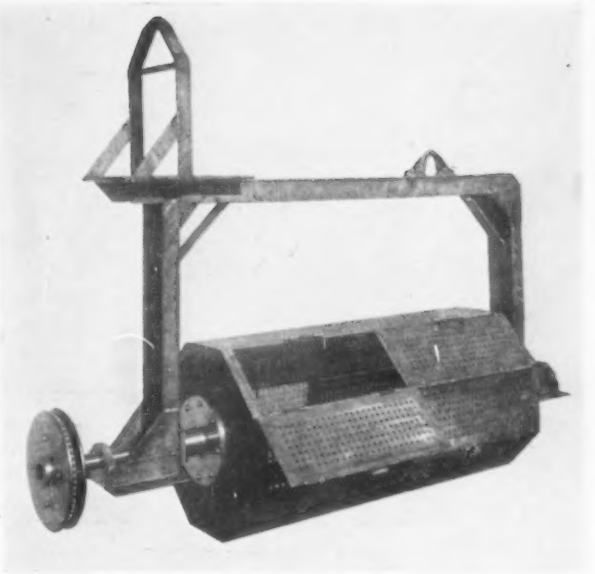


Fig. 3. Stainless steel pickling barrel resists severe corrosive conditions.

Emulsion Pretreatment

Penetration of the grease film and impregnation of surface soil with a balanced combination of an emulsifying agent and mutual solvent form the dual objective of precleaning, so that the layer of surface contaminants is converted into a soluble oil when treated with the rinse water, preferably by spray means as this procedure is decidedly superior to an immersion rinse from the effectiveness standpoint. While this emulsion precleaning may remove from 50 to 90 per cent of the deposits present, its final object is not to remove all surface contamination so much as it is to "condition" the soil so that it may be speedily and surely stripped from the work by brief immersion in the subsequent hot alkaline cleaning bath.

Depending upon the severity of the forming oil removal problem, the emulsion-type precleaning agent may be used at full strength or may be diluted with a petroleum-type degreasing solvent in various ratios. Generally speaking and based on experience of numerous plants, the emulsion degreaser is diluted with an equal volume of Stoddard solvent or kerosene. Immersal time in this precleaning mixture varies according to several factors, namely: type of grease, porosity of metal, and to some degree, composition of alloy. Steels alloyed with chromium are notably difficult to wet out thoroughly and effectively.[13]

Alkaline Still-Tank Cleaning

After deposits have been thoroughly softened and loosened by precleaning with an emulsion dip such as that described, the main cleaning job is accomplished by the still-tank method, which simply requires a rectangular tank, source of heat, water, and a supply of the proper alkaline-type cleanser. Typical concentrations of solutions range from 6 to 8 ounces of chemical cleansing compound to each gallon of water.

Solution is maintained at a minimum temperature of 180° F., or higher whenever practicable and to as

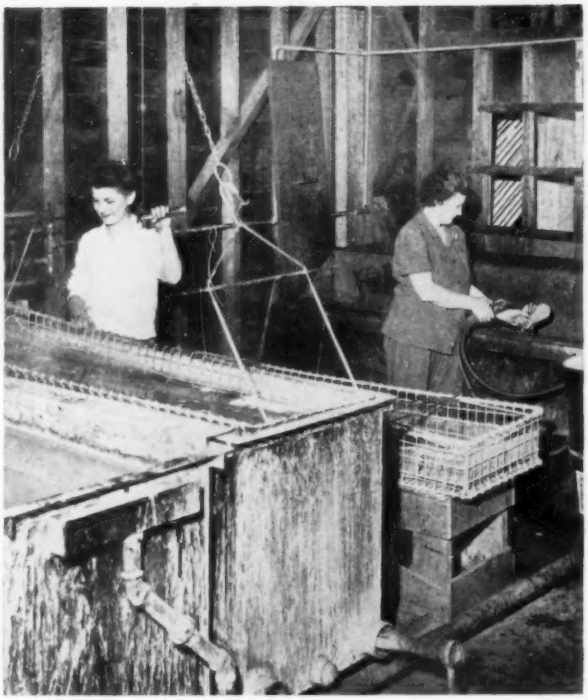


Fig. 4. Soak cleaning stainless steel in alkaline bath before electrocleaning.

near boiling as possible. A high temperature is suggested not only because it has been widely demonstrated that a hot solution assures more complete saponification of the saponifiable portion of the grease but also because such a temperature creates a rolling agitation that produces a highly beneficial scouring-and-scrubbing action to insure more thorough removal of deposits from the work.[13] In other words, to put the proposition axiomatically: the nearer the temperature to the boiling point, the greater the agitation of the cleaning bath, and consequently, the greater the speed and efficiency of cleaning. Limits are usually set at 180° F., to 212° F.[14]

Still-tank degreasing with alkalis can be stepped up appreciably when an induced circulation of the cleaning solution is "engineered" into tank design and operation. Such a "built-in" construction feature speeds up grease removal and oil dissolution from work surfaces in two ways: (1) It removes the stagnant layer or scum of saturated cleaning solution from the vicinity of the metal surface, continually exposing fresh solution to contaminates; (2) It provides a mechanical scrubbing or scouring effect to complement chemical cleaning action.

A "rolling" solution or continuous agitation may be obtained easily by various means. Of these, some of the most commonly utilized are injections of compressed air at the bottom of the tank, installation of a propeller and appropriate baffles within the tank, use of an external circulating pump, or simply capitalizing on the thermosyphon effect of the natural convection currents. Various heating arrangements, such as heating the solution with baffled steam coils or immersion gas burners along one side of the tank or applying gas directly under the tank, may be used to secure the benefits provided by convection currents.[13]

Rinsing

Quality of results obtained in most alkaline degreasing operations is determined in large measure by the effectiveness of the rinsing operation following the cleaning. Tank should be continuously overflowed to keep the rinse water as contamination-free as possible. Best method to accomplish this involves the introduction of fresh water at one end of the tank by means of an inlet pipe towards the tank bottom and the use of a weir or box overflow at the other end.[14]

With such an arrangement the surface is continuously skimmed and the entire rinse solution kept comparatively free of contamination. Usually, rinse water temperatures range between 180° F. to 212° F. In rinse tanks, as in cleaning tanks, best practice calls for installation of heating coils on the sides of the tank at the back, or, if possible, away from the overflow since this provides better solution agitation and also does not interfere with the overflow's skimming action. When steam jets are utilized, they should be directed towards the opposite side of the tank from the overflow.[14]

Electrolytic Cleaning

To further expedite and improve alkali cleaning, electric current is being increasingly utilized. When this method is used, the work to be degreased serves as one electrical pole and steel electrodes are inserted in the tank to serve as the other pole. In a great many cases, the tank is used as one electrode, but this practice is not recommended as best standard procedure by many authorities since it has been discovered that electrolyzing of the tank shell tends to cause weakening of the welds and dissipates current uselessly.

To increase the effective amount of edges available for the current to enter the solution, separate electrodes are preferred over one continuous sheet and should, moreover, be pierced with holes so as to increase the edge area still further.[13] Use of separate cathode or anode plates also allows better control of the current and makes it possible to remove the plates for cleaning.[14]

Should the work to be cleaned be made the anode or cathode in the solution?

An intensely interesting question, that. So much so, in fact, that it long has been the storm-center of hot debate throughout metal-finishing circles. Much can be said for each of these two procedures, which are often called "anodic degreasing" and "cathodic cleaning" to differentiate one more clearly from the other.

While electrocleaning of steel today often continues to be performed cathodically, the past few years have witnessed a marked upsurge in cleaning steel anodically to obviate carbon smut deposition as so often encountered with the cathodic cleaning cycle. Gas liberated at the cathode is double that evolved at the anode, so to produce the same degree of agitation, the current density for anodic degreasing must be twice as great as for cathodic cleaning.

On the other hand, metallic impurities in the solution tend to electrodeposit on the metal during ca-

thodic cleaning. In numerous plants the electrocleaning tank is equipped with a double-throw switch in order that the work may be cathodically cleaned first to secure maximum gassing and then anodically degreased to deplate electrodeposited dirt.

Current densities used in electrocleaning commonly range from 10 to 100 amperes per square foot, but these rates are sometimes exceeded when all the cleaning is performed anodically. As much as 12 volts have been used to produce a violent evolution of gas in basket-cleaning of small parts.[13]

Conductivity of the soil-removing bath, a vital requisite to electrocleaning, may be increased in one of three ways. First, by using within certain limits a concentration of cleaning compound above and beyond that simply required for dirt removal; second, by making certain that the work is kept within proper proximity to the electrode; third, by increasing the temperature of the solution.

It has proved definitely preferable in the majority of instances to take full advantage of the higher conductivity of more concentrated solutions. Amounts of specially-developed anodic-type cleaners ranging between 6 and 12 ounces to the gallon of water are quite commonly employed in modern electrocleaning technique. Temperature, of course, should be maintained at a point as high as reasonably possible, with 180° F., preferably as the minimum.[13]

Certain key conclusions on electrolytic cleaning may thus be summed up as follows:

It is generally one of three types—cathodic or direct current cleaning, anodic or reverse current degreasing, or a cathodic cleaning-anodic degreasing combination. The advantage of cathodic cleaning lies in the fact that twice as much gassing is obtained at the cathode than at the anode. A disadvantage, however, is presented by the fact that any metallic, and even some nonmetallic, ions are deposited when the work is the cathode. The advantage of anodic degreasing comes from the fact that since the ions are traveling in the opposite directions, there is no danger of deposits. While it frequently is the practice to make the tank itself the opposite pole in the circuit, suspension of separate cathode or anode plates has proved preferable for this purpose.[14]

Other Cleaning Methods

Grease and oils are also readily removed by vapor degreasing with chlorinated solvents, such as trichlorethylene, or by washing with organic solvents such as carbon tetrachloride, kerosene or gasoline.[7] It may be advisable, however, to follow either of these treatments by a thorough water wash and a dip in hot 10-20% nitric acid.[9] And if the work is not too heavily contaminated, it also may in many cases be satisfactorily cleaned by automatic machine or power washer equipment utilizing either emulsion spray cleaners or alkaline detergents.[8, 14]

Removal of machining compounds and spinning lubricants also is, basically, good pre-annealing practice for the same reasons and considerations that govern drawing compounds.[9] This cleaning operation, likewise, may be handled by dip-tank cleaning, electrolytic degreasing, or in some cases (where contamination is not excessive and the deposit too tenaciously adherent in character, and if size and shape of parts permit), by power machine washing.

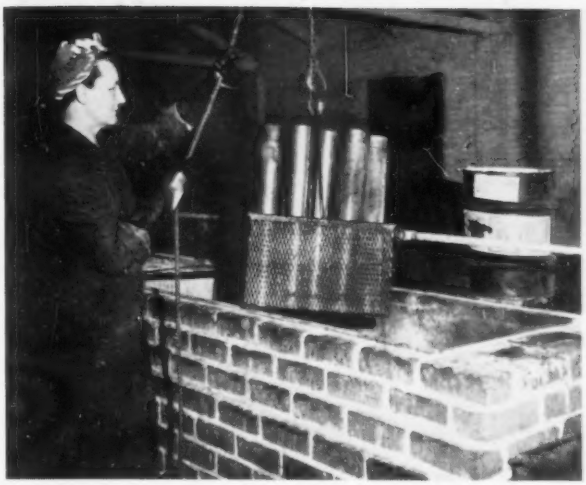


Fig. 5. Cleaning stainless steel in a cold emulsion type cleaner.

After parts have been put in clean, grease-and-oil-free condition, quick drying and careful handling are important to prevent contamination of the surface prior to annealing.[7] Parts should be handled with clean gloves or tongs, since any smudge or spots, if permitted to remain on work to be annealed, will be burned into the steel.[3]

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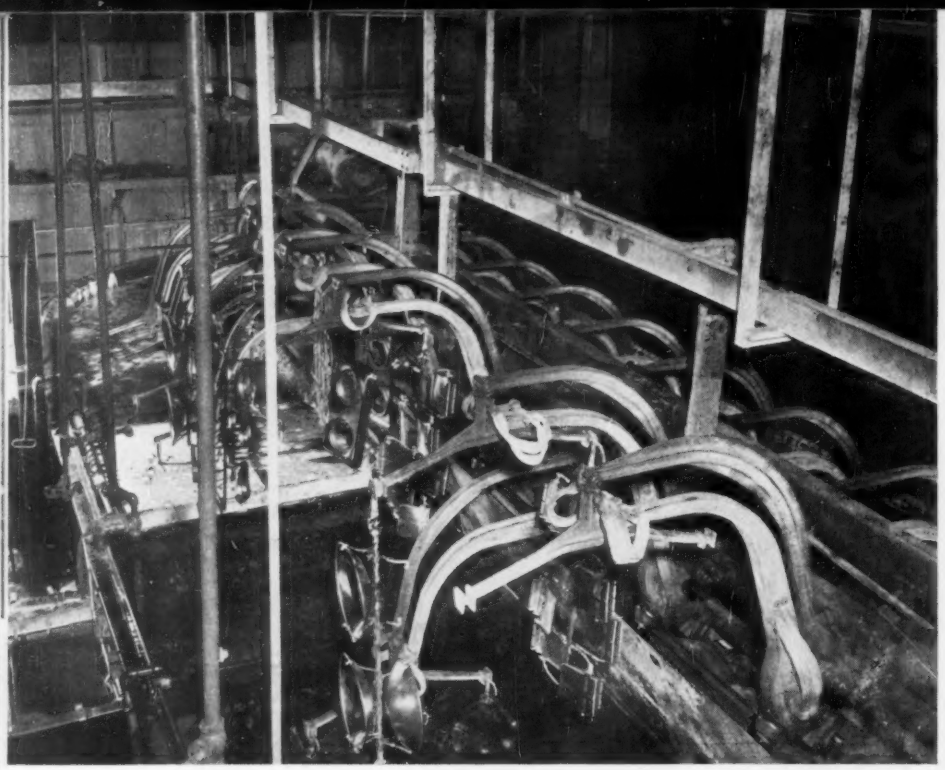


Figure 1. Parts being plated with nickel in a full automatic machine.

Finishing Small Electric Appliances

By Gerald Eldridge Stedman, *Chicago, Ill.*

PRODUCING a broad line of small electric appliances featuring such items as heating pads, space heaters, vaporizers, fans, mixers, liquidizers, toasters, grills, infra-red lamps, corn poppers, juicers, curling irons, waffle irons, hair dryers, whippers, vibrators as well as such other distinct products as Aerosol insecticide bombs, syphon bottles and CO_2 bulbs, the production of Knapp-Monarch Company of St. Louis, Missouri is varied and complex. Actually, the run of work through this plant staggers the imagination, requiring unusual keenness and control in engineering, tooling, scheduling and shop practice. Daily production involves some 80,000 separate major parts.

Because the products are designed with unusual attention to eye appeal as well as functional efficiencies, very much of this production requires nickel and chrome plating. Nothing concerning its plating methods has been previously published.

The plating department is under the supervision of John Vogt, with the company 17 years. The department is compactly housed in a 200′ x 200′ area, the square footage about evenly split between nickel and chrome plating activities. During some working days, as many as 50,000 pieces are plated in this area. The set-up is completely conveyorized and the department employs 75 people.

Nickel plating operations usually handle from 15,000 to 25,000 pieces per day in a complexity of shapes, sizes and contours, causing a variety of racking and plating requirements.

The firm makes all its own racks in a production and coating balcony aloft, in front of the general plating floor. Its going inventory is 3,000 racks. These racks are coated with a synthetic rubber to prevent building up nickel deposits or otherwise contaminating the plating process. Coating for nickel racks lasts from three to six months. In chrome plating, rack coating lasts the life of the contact points which have to be replaced occasionally. The injury to the coating caused by this replacement is taped. The rack inventory is balcony-stored, raised or lowered to the floor by electric hoist, racks being returned to balcony stands as they conclude cyclical travel and are no longer needed.

Three rack types are used, designed and evolved by Vogt to facilitate carrying the great variety of work passing through plating. Each handles from one to 100 pieces.

There is a straight spine rack. Second, there is a rack design having a series of cross member ribs for small work. Finally, a U-design rack with contact points on both sides is used. In addition, barrel holders are used to plate very small pieces, such as nuts, bolts and washers which cannot be racked.

Work comes from the polishing department where much of it is polished automatically on a continuous

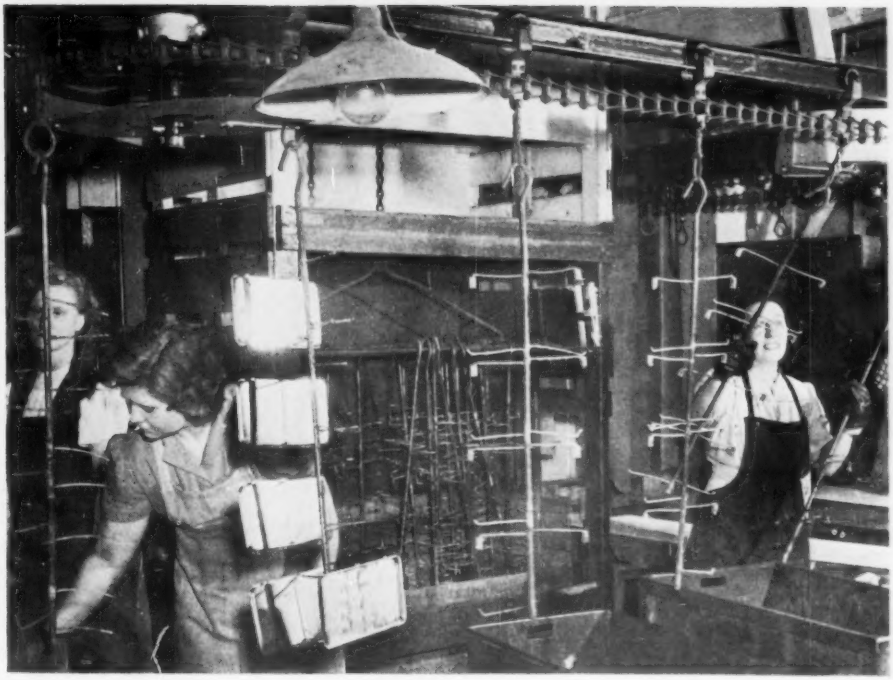


Figure 2. Plating racks being delivered to the plating room floor by conveyor after they have been unloaded. Note repaired and new racks being lowered to this station (center background).

belt passing under a buffing sequence that is, in itself, unique. Girl operators in the plating department receive it, rack it and hang it on the overhead conveyor line. This is No. 458 chain, traveling at 10 ft./min. Though no precise order can be maintained, there is an attempt to batch pieces for like runs when possible.

Work is transferred at the degreaser station from overhead conveyor to the degreaser line where it passes through a fully automatic, vapor-phase degreasing machine. This is facilitated by three tanks: (1) a boiling chamber of about 188° F., (2) a rinse chamber at about 160° F. and (3) a vapor chamber at vaporizing temperatures. A straight solvent wash is used in all chambers. The cycle through the degreaser is 7 minutes.

From here, work is transferred to the fully automatic nickel-plating machine, facilitated by a series of automatic traveling arms which carry the racks through the sequence of plating baths. The sequence follows:

First, the work receives an alkali bath, using a prepared cleaner in solution of 8 to 12 oz./gal. water. This tank's capacity is 1000 gal., water is at 212° F., boiling temperature. It uses 6 volts reverse current. Submersion is 2 minutes.

Next, a spray rinse of 20 seconds in constantly flowing cold water brings the work to the 10 per cent muriatic acid pickle where it remains 56 seconds. It then receives another cold running water rinse of 20 seconds, and comes to the sulphuric acid dip.

A solution of .05 per cent sulphuric acid is used,

Figure 3. Loaded racks coming from degreaser being loaded on arm of automatic plating machine.

the purpose here being to keep the pH of the nickel in balanced adjustment.

In the sixth phase of the sequence, the work goes to the bright nickeling tank. The work is removed in from 7 to 11 minutes. Current density is 20 to 75 amps./sq. ft.

Thereafter, the work moves to a spray rinse for 20 seconds, and then to a running cold water rinse for 20 seconds, after which it receives a final hot rinse at 180° F. Coming from the automatic plating machine, racks are transferred by girl operators to the overhead conveyor and thence move to dryer.

The dryer is equipped with heaters using steam from the central plant system. Conveyor travel in the dryer moves in a 50′ S-formation. Cycle time is 7 minutes and temperature is 120° F. The oven is fully enclosed; work emerges from the dryer to be unracked by girls who place it on an endless belt for inspection and delivery to buffing department, packing or storage.

All solutions in the nickeling process receive analysis once each week. Some are checked daily. For example, brightener and other additives are used to restore proper solution balances each day.

Chrome plating also handles a volume between 15,000 and 25,000 pieces per day. This type of plating is particularly required on those items of the line that are exposed to high temperatures in use conditions; the majority of products using electricity in some heat application.

The work for chrome plating comes likewise from the polishing or buffing departments and is transferred to the fully automatic chrome plating machine where it goes through the following sequence of treatment.

The work receives an alkali bath, using a 5 oz./gal. solution of a proprietary cleaner for 2 minutes. Then it moves through a running cold water rinse for 2 minutes, and into a 2 per cent muriatic acid dip for ½ minute, then into another cold running water rinse for ½ minute, and thereafter the work comes to the plating tanks.

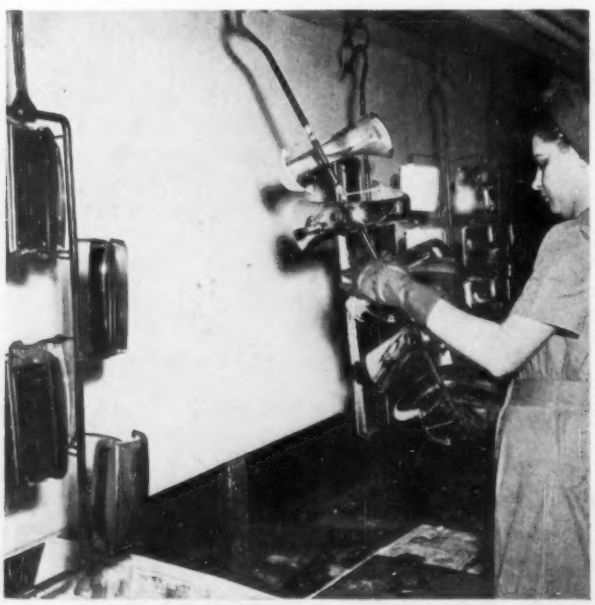


Figure 4. Chrome plated parts being inspected under powerful fluorescent lighting. Note white background for better vision.

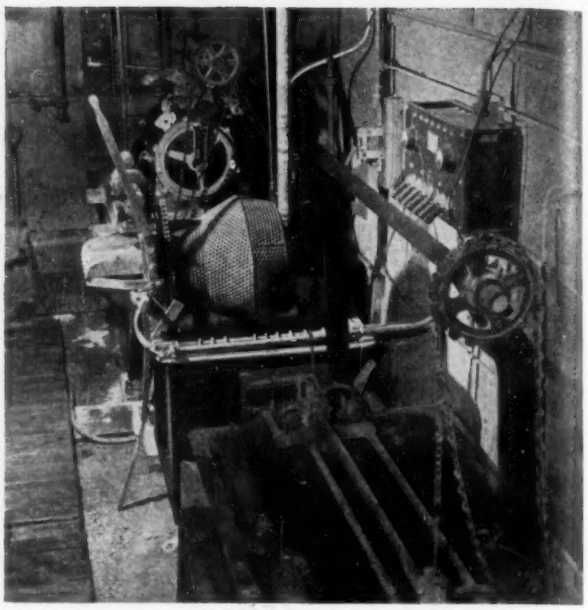


Figure 5. View of the barrel plating section, showing the variety of equipment used.

The chrome plating tank employs a current density of 100-200 amps./sq. ft., using conventional chrome solution. Submersion is 2 minutes.

The work then moves to a cold running water rinse for ½ minute, and into a spray rinse for the same interval, finally coming to a 150° F. spray rinse. Here it is transferred to an overhead conveyor which moves under a battery of powerful fluorescent lamps as the racked work travels past a pure-white screen background. In this manner, it receives inspection. Such work as did not plate sufficiently is removed. There are two women inspectors at this station.

Reject total of nickel and chrome plating runs between one and three percent, evidencing an unusually high plating efficiency, particularly considering the variety of the work.

From inspection, chrome plated work passes through a dryer, identical with that described previously in nickel plating. It is then unracked onto a continuous belt for a final inspection, and moves to be chrome buffed, packed or stocked.

The conveyor accommodates 200 racks/hr. in chrome, and a total of 300 racks/hr. in nickel plating; the latter by two machines, located in parallel. The nickel cycle is 20 minutes of total travel time; that of chrome is 10 minutes.

Three generators accommodate the electrical requirements of these automatic platers. They are 7500 amp., 9 volt units, housed in a semi-air conditioned room where air is moved in through filters and exhausted outside the building by suction blowers, preventing contamination of all inside air with dust or dirt.

A varied amount of supplementary plating is accomplished in the department. Some stainless steel is pickled. All dies, tools and reamers are hard chromed to lengthen tool life. Gages are repaired by hard chroming. Many miscellaneous small parts are treated in barrel platers for nickel, tin, cadmium plating. About 200,000 such very small parts are handled in this manner per day.

First Annual Meeting of the National Electroplaters' Ass'n, New York, 1910.

All Our Yesterdays—Part VII

By George Spelvin

AS WE turn our attention to the year 1909, in our somewhat frivolous backward glance through the pages of yesterday's journals of the plating trade, we become aware for the first time of a subtle change. Quite suddenly, as it seems, we have much less to chuckle at: the question-and-answer columns consist of perfectly reasonable requests for information, which are just as sensibly complied with, and we seek in vain for the "dumb" question or an obvious boner in the editor's reply. The same is true, by and large, of the remainder of the journals' contents. (Will this salutary trend continue in 1910? Or will Joe Plater backslide?).

It was a relatively quiet year in the newspapers, too. The Supreme Court made the headlines quite frequently, for the big-stick policy of TR had resulted in many lawsuits by the government against various trusts; the high court in most cases upheld the Justice Department and a series of whopping fines were paid by railroads, oil companies, sugar trusts, and others. On March 4 the first Roosevelt era came to an end as W. H. Taft was inaugurated, and on the 23d the irrepressible TR sailed for Africa on a "scientific" expedition. On February 15 the Peary expedition arrived at Cape Columbia (7 persons and 50 Esquimaux, was the way one writer enumerated the party. Are Esquimaux people?) On March 1 Peary and Henson, with four Esquimaux (Eskimos to you) began their dash for the pole, passed the 88th parallel on April 2, the 89th on April 3, and on April 6 triumphantly stood at the top of the world. But the news did not reach civilization till much later, as we shall see.

Meanwhile the electroplating fraternity were reading the editor's estimate of the progress made in 1908: "New electro-mechanical plating devices were among the features of 1907; comparatively few of these inventions have been noted in 1908, what were brought forth being mainly new patents on minor improvements over existing types.

"The industrial setback early in the year affected the plating trades quite seriously, particularly in the collection of accounts. The inability to meet payments for material was eased in a measure by the plating supply houses extending extraordinary credit, and the practising of economies by all concerned."

Our counterparts of 1909 apparently liked nothing better than a good argument, and the correspondence columns of the trade press re-echoed with verbal sallies and sarcastic ripostes. The controversy over the cleaning of nickel anodes, already noted in a previous instalment of this series, was still going strong. "The storm of protest and denunciation brought forth by my letter on cleaning nickel anodes . . . is, to my mind, a great deal like political mud-slinging, and as such is scarcely deserving of an answer." [That did not prevent the answer from occupying 1½ pages of small type]. "I should say most emphatically that the English, French and Germans have shown as much, if not more, progress in the art of electrodeposition than we have in America, and also they are not tied down by old methods and trade prejudice against suggested improvements from electrochemists. . . . The length of this letter is greater than I anticipated . . . but . . . I trust that [it] will merit reply and further literary pyrotechnics from my well-appreciated criticizers."

It did. An editorial olive branch was offered, without notable success: "The discussion running in our Criticism and Comment columns for the past few

months, on the subject of cleaning nickel anodes, has now reached a point where it is deemed advisable to pour a little oil on the troubled waters. . . . There are two sides to every question and it seems to us that now both parties have set forth sufficiently their most telling points. At the present writing it looks as though the anti-cleaners were in the lead, both numerically and in the force of their arguments. . . ."

Many side issues arose and the discussion at times descended to the "you're another" type. Faraday's laws were tossed back and forth; a correspondent wrote *5 grs.*, was understood to mean *5 grains* when he really meant *5 grams;* he was taken to task and told that the abbreviation for *grams* was *gm.* This required three exchanges of letters to the editor; meanwhile there were arguments over the density of nickel deposits, whether or not nickel can be deposited from single salts, and so on. Finally, one of the contestants tossed in the towel: "There has been sufficient digression from the point at issue on the anode question and it has developed into a personal battle between two opponents. I for one feel that the arguments had better cease until they can again be brought up before the National Platers' Society, where such discussions should be conducted. I will therefore close my part of the discussion with this letter."

And the subject of discussion was neatly switched by a correspondent who had larger aims in view: "I have been deeply interested in the controversy over the cleaning of nickel anodes and have read both sides of the discussion with much interest. I am sure this discussion proves that once in a while the plater will come out of his shell and expose himself, especially when there is danger of some of his own exclusive thoughts and pet theories becoming overthrown in the light of publicity. Such discussions as these are what we need. This is the very reason why today we need an association of platers, national in its scope. . . . Well, Mr. Plater, what are you going to do? Once in a while you will come out of your shell and show that you can fight when you want to. You have a thinking mind. Don't you think it is about time you thought of an association that would be national in its scope? Not for you alone or I, but for the welfare of us all?"

Agitation such as this, ungrammatical though it was, bore fruit and the Association of Platers, dreamed of for several years by a few pioneering spirits, finally became a reality. We may watch its progress in the editorial columns. "Judging from the enthusiasm shown at the first meeting of Foremen Platers, held March 6 . . . and also from the letters . . . from out-of-town platers, there need be no question raised as to the ultimate success of the society. . . . Matters have progressed to the point of producing a spark and it now rests with the platers of America to so foster that spark as to cause a fire strong enough to weld together all of the platers of this continent in one solid body. . . . The question has arisen as to just how far a plater might go in imparting knowledge, which it might be claimed belonged to his employer; this is a matter which will really take care of itself. . . . The Platers' Association will soon be in a position to impart information rather than to seek it. . . . We are of the opinion, that in a few years from now the secrecy now claimed to be prevalent in the plating business will be a thing of the past, and there will be in existence standard formulae for the more common plates and finishes."

The next month there was further comment: "The Association of Electroplaters of the United States and Canada is now a fact. . . . The original idea was to confine the membership to foreman platers only, but such widespread interest has been displayed that the scope has been broadened to include not only the class mentioned above but also anyone who is interested in the electrodeposition of metals as well as anyone whose services may be considered of value to the association."

Finally, in December we may read that the name of the organization seems to have changed once more: it is now the National Electroplaters' Association of the United States and Canada; and at its 10th regular meeting, on December 4, 1909, "The President of the International Association of Platers', Polishers' and Buffers' Unions requested the privilege of the floor, but upon vote this was denied on the ground that the Association is positively opposed to Unionism. . . . [it was reported that the average salary of the foreman plater as taken by count at a previous meeting was $27.50 per week.]"

Although the Noble Experiment was still ten years in the future, premonitory omens continued to disturb the topers. On January 12 the Tennessee legislature passed a state prohibition act, and on the 21st repassed it over the veto of a courageous governor. In February Wyoming banned the sale of liquor outside the limits of incorporated cities and towns; later in the same month Idaho adopted local option, and in March Washington followed suit. It was a fairly quiet year on the labor front: there was no general coal strike, though local stoppages by miners did occur. Principal labor disturbances were strikes of street railway workers: these took place in Trenton, Philadelphia, Chicago and Pittsburgh. The transportation industry made news in other respects also: three times the S. S. Mauretania broke its own eastbound record, and on May 10 concluded a crossing in 4 days 18 hours 11 minutes. On April 1 the seventh transcontinental railroad system was completed as the Chicago, Milwaukee & St. Paul reached Seattle and Tacoma; and in July, Orville Wright established two records: on the 27th he carried two passengers in his plane in a sustained flight of 1 hour 12 minutes 40 seconds, covering 50 miles at an average speed of 40 miles per hour; on the 30th he covered 10 miles in 14 minutes 42 seconds, and on the basis of these two performances his flying machine was accepted by the Government.

The subject of health hazards in the plating shop was actively discussed during the year. It was introduced in an article on the salt-water gold-plating process, whose author said,

"The greater part of the reading matter presented to the plating public at the present time is of a purely theoretical nature. While I do not deny that this theory has its many uses and is of great advantage

to the profession, I maintain that in very many instances it is far more advantageous to resort to practical means and work towards better results from the standpoint of practical experience, rather than entirely from theory, in the trade."

The advantages claimed for the salt-water gold are greater uniformity, lack of necessity for a dynamo, lack of care required in operation, and

"In the ordinary methods . . . the plater is really in danger from the injurious gases arising from the solution, and in case he has any abrasions or cuts on his hands, is constantly open to the contraction of cyanide poisoning—a malady far too prevalent among gold platers."

These remarks prompted a correspondent to write that 'Few if any of us have not encountered rooms where the ventilation was so bad . . . that employees from other departments could not stand the overpowering odors. . . . I have seen men working where the cyanide fumes filled the whole room and settled in such quantities upon the pipes as to whiten them. I have seen men in this room so affected that it incapacitated them for weeks, and the effects were so painful that breathing was a difficulty. . . . I have known the platers to be covered with the most disgusting sores, over more than half their body, and the head plater in this room was carried out, completely prostrated from the fumes of the hot cyanide solutions." The remedy proposed for these conditions was more stringent legislation and stricter inspection.

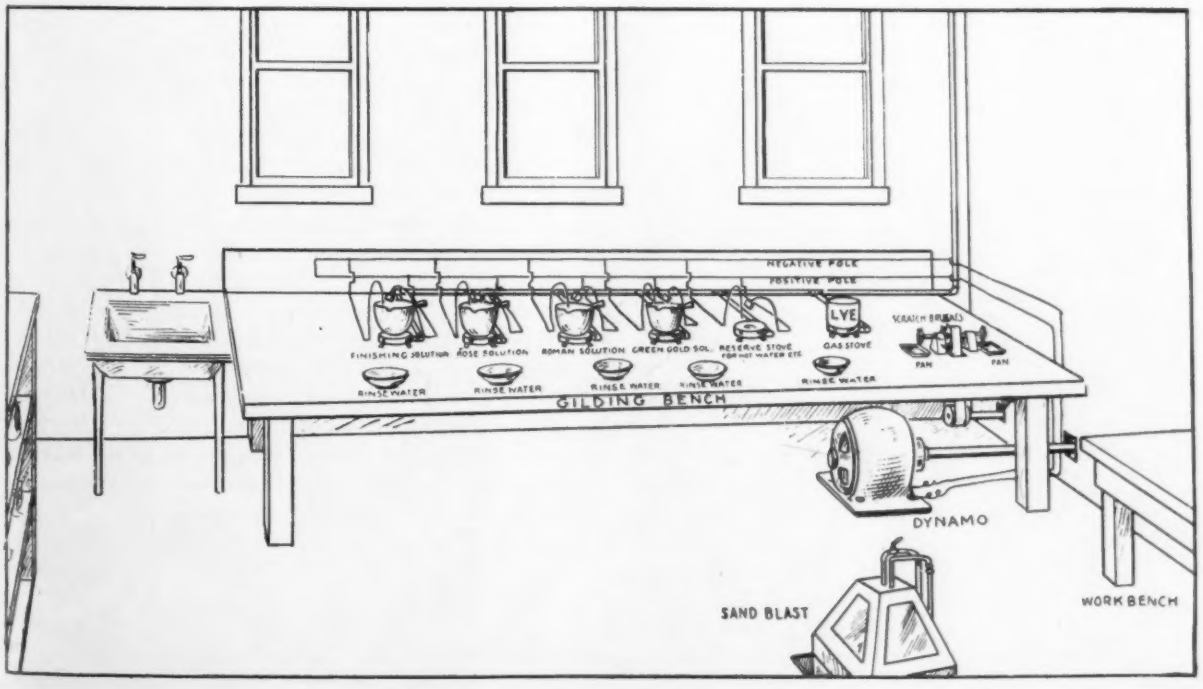
Another correspondent added: "I think it is about time somebody woke up to the fact that a large percentage of the plating rooms in New York City and elsewhere are filthy, unsanitary and unfit for men to work in day after day breathing in an atmosphere laden with the fumes of acid dips, hot cyanide solutions, etc. . . . I hope that the platers . . . will get together and work for better conditions in the plating room."

The editor joined in with the suggestion that the recently formed National Electroplaters' Society study the problem.

Meanwhile a particularly articulate plater took occasion to settle an apparently personal score with consultants, in a burst of eloquence which deserves quotation at some length:

"It is a well established fact that the formulas for plating and coloring solutions that call for a large variety of chemicals appeal more forcibly to the average colorer than the ones that require only a few ingredients. One of the principal reasons why the illusion exists that the more chemicals added to a solution the better it will work is that the ordinary colorer has acquired his knowledge of the business by working as an assistant in a coloring room and knows practically nothing about electricity or chemistry. As soon as a solution . . . works improperly . . . he is at a loss to understand why the solution falls down, and invariably begins to dope it up with 'conducting salts' (usually some form of soda) and if the addition improves the color temporarily, imagines he has discovered a secret of inestimable value. He promptly sends the valuable secret (?) to all the trade journals he knows of, with the idea that by so doing he is helping his brother colorers and creating for himself undying fame as a great philosopher.

"Another prolific source of fake formulæ is the unscrupulous consulting plater who advertises to sell infallible formulæ for every conceivable dip or solution, and if a colorer is foolish enough to send for any of them he receives a receipt that calls for from 5 to 10 different chemicals with a lot of directions for using that are not worth the time it takes to read them.



General arrangement of jewelry plating room.

The type of consulting platers referred to can easily be recognized by their advertisements, as they usually advertise to furnish formulas for plating, coloring, etc. with such explicit instructions that the amateur plater can . . . 'immediately obtain a pleasant, highly lucrative position as superintendent of a coloring room.' A wrinkle that is commonly practiced by them is to advise the colorers who seek their counsel, to install large solutions and dips so that after the improperly made solutions fall down the colorer has a lot of elephants on his hands that have cost a great deal of money and have been almost useless, so he goes to the consulting plater again and gives him an opportunity to extract another fat fee.

". . . While any article that has received a deposit of metal from a solution with the aid of an electric current is properly called electroplated, the word 'plated' is universally used to designate articles that have received a heavy deposit; articles that have received only a light film of metal are called colored.

". . . These comparisons of the two branches of the art show that a man may be a first class plater and yet know nothing about coloring. It is the colorers that are most imposed upon by people who, through ignorance, or a desire to mislead, sell or cause to be published formulæ and directions that are so obsolete and ridiculous that they are a reminder of the days of the alchemist and spagyrist. This series is written to show the folly of using superfluous chemicals when compounding a coloring solution."

(A spagyrist was an iatrochemist. Now aren't you glad you asked?)

We have noted previously in this series the persistent and well-nigh universal error of referring to "a current of X volts," nor did the writers of 1909 improve notably in this direction. But the converse error makes its first appearance in an article on Electrogalvanizing:

"I would like to suggest a cold electrogalvanizing solution which I have no doubt surpasses any of those being used by the trade in general . . . This process is entirely unlike previous methods, and no longer depends on dissolving of zinc anodes to keep the electrolyte in good working order. . . . The solution is: 1 gallon water, 2 lbs. sulphate of zinc, 2 oz. sulphate of aluminum, ½ oz. glycerine. E.M.F.—10 amperes per sq. ft. The work must be agitated while being coated; for this purpose there are many apparatuses on the market. . . . In this solution it is imperative that pure zinc anodes be used. . . . The writer invites criticism."

This time the unfortunate author elicited a prompt and sarcastic reply:

"The author claims that the process does not depend on the dissolving of the zinc anodes to keep the electrolyte in good working order and yet, further on, he says that it is imperative that pure zinc anodes be used. Purity being the antithesis of dissolute conduct, I suppose this is the philosophic basis of the scheme. We are not informed how the anodes succeed in keeping their hands folded and their eyes lowered and we must assume that when the solution runs out of zinc, zinc sulfate is added.

". . . The agitation of the work will, of course, increase the speed of deposition and will be specially useful in connection with the anemic solution proposed . . . , but as the devices referred to are usually for the purpose of agitating the *solution* I presume that this is what he meant—in the end *'es ist alles Wurst.'*

". . . The point which is most liable to injure the growing reputation of electrogalvanizing is the author's recommendation: 'E.M.F.—10 amperes to 1 sq. ft. of surface,' an hydraulic equivalent of which would be, 'Pressure—10 gallons per sq. ft.' Why not? Did they not sell furniture by the yard in Harrisburg? But seriously, is it not dangerous for anyone who confounds electromotive force with current-density to 'monkey' with electrical machinery?—I was thinking about the safety of the machinery.

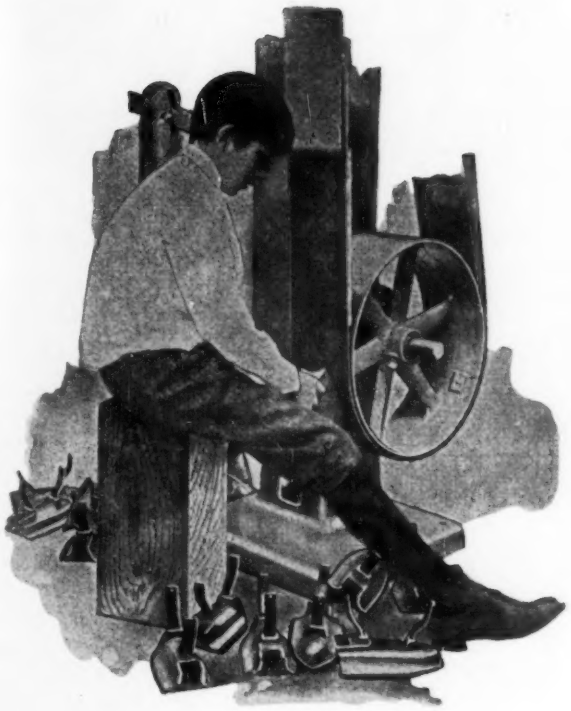
"Let me hasten to assure the uninstructed that a current density of 10 amperes per sq. ft. in zinc-plating is, as far as I know, surpassed by the meanest of . . . solutions . . . For my part, I would feel very sad . . . if I couldn't get 50 amperes per sq. ft. through the solution. . . . Instead of the old-time 'lick and promise' you can nowadays lay on a coating in which you can plant pins and which you can pare off in chunks, but most wonderful of all, you can even satisfy 'ye ancient inspectour' with his sulfate of copper dip, in which, as the very late Earl of Sandwich said, 'Iron changeth to fyne golde.' "

Thoroughly cowed, the author could offer only a weak apologia: "I owe an apology to your readers for my erroneous statement in suggesting that zinc anodes were not necessary to keep the electrolyte in good working order, as I should have stated that they are not absolutely necessary for that purpose alone. They are, however, absolutely necessary in the solution itself. This criticism is however of minor importance. . . . If this process is as old as the art itself to our friend, it is new to me and I dare say to the average plater . . .

"As stated, the E. M. F. which was made to read 10 amperes to a square foot of surface was incorrect: this of course should be that a current of 10 amperes was necessary for this solution."

The problem of plating on aluminum had been under study for many years, so that it must have pleased the plater to read that "The problem of plating aluminum with some metal resisting corrosion is claimed to have been solved at last. The plating bath used in the new process is a solution of the metals to be employed in alcohol and excellent results have been obtained with gold, copper, and nickel, although silver and lead proved unsuitable. The results with zinc and platinum have been indifferent. A current of 2½ to 3 volts [*here we go again*] is used and the aluminum to be plated is first connected to the anode to remove the oxide, the connections being then reversed. Oxide does not form again, a clean surface being obtained that satisfactorily takes the plating metal deposit."

Although a successful chromium bath was still almost twenty years off, the metal was not being forgotten. We read that "Chromium is not a rare metal and it is possible to obtain good electrodeposits of it. The future will undoubtedly find it extensively used



. . . Cowper-Coles some time ago found that bright chromium deposits could be obtained from: Water 1 gallon, chromic chloride 3 lbs. Plating is done hot, about 190° F, at a current density of 40-50 amperes per sq. ft., at a pressure of 4 volts. [*We're improving.*] Some hydrochloric acid is necessary."

And in the same issue of the same journal: "The electrodeposition of chromium, on account of the hardness and noncorrosiveness of this metal, seems to hold out considerable promise. The numerous investigations carried out from time to time will undoubtedly bear fruit in the near future."

Another coming event cast its shadow, as an author proposed the use of electrotinplate to replace hot dip. Electroplated coatings, he said, were more uniform; and he advocated the use of a fluosilicate bath with glue as addition agent. Further, we note that "It is . . . of great importance to the trade at large that there has been perfected a process for the electroplating of steel in very long strips. These strips can be finished in nickel, copper, brass, etc."

An interesting engineering application of electroplating was described: "What would seem to be the largest single piece of work ever plated was recently completed . . . The article . . . was a cast iron wheel 10 feet in diameter with a 4-foot face. The wheel was first plated with a heavy coat of copper. After polishing it was next run in a cyanide of potassium solution and then in a quickening (?) silver bath. . . . Following this preliminary process came the real operation of plating.

"A solution of silver was made carrying six ounces of silver to the gallon and the wheel was plated until about three-thousandths (?) of an inch had been deposited. A specially constructed dynamo giving a current of three volts and a density of 0.25 amperes was used. The wheel was revolved at a speed of 2½ revolutions per minute throughout the whole process."

Some light is thrown on the practice of nickel plating by some helpful hints regarding sediment in the tanks: "Some platers allow so much sediment to build up in the nickel tank that it causes short-circuits. When sediment rises to a height that covers the bottom of anodes and work, shortcircuiting is apt to result. Further, we find a note on the disadvantages of leaving work in the bottom of a nickel tank. The writer claims to have known cases where a bushel or more has been accumulated. The difficulty, is, he says, that nickel solutions are too dark to see through and material which has fallen from the racks is not noticed.

And the question-and-answer columns give us a glimpse of a thrifty plater whose economical proclivities appear to have been misdirected: "Q—I have been saving the slime from my nickel anodes and now have about 300 pounds. Is this salable? Who might be interested in purchasing it? A—Nobody, as far as we know, would be interested in buying this material. You might as well throw it away."

We cannot do better than to end our survey of 1909 on an optimistic note, found in an article on Spotting-Out Troubles: "No matter what the composition of the metal is, if knowledge and 'horse-sense' are exercised, all difficulties in the plating room will be overcome." Would it were so; or maybe there just aren't enough horses in the plating business.

On September 1, Dr. Frederick Cook claimed to have reached the North Pole on April 21, 1908; and on the 6th Commander Peary notified the world that he had reached the Pole on April 6, 1909; on the 13th Peary denied Cook's claims categorically. On the 21st Dr. Cook reached New York and was acclaimed as the discoverer of the Pole, but on Novemver 3 the National Geographic Society accepted Peary's log of his journey as authentic, and as the year drew to its close, on December 21, an International Committee decided that Cook's record was, to say the least, unconvincing. So ended one of the most famous geographic hoaxes of modern history.

Three items in the daily news of this bygone year have a more ominous ring for today's reader: on July 13 there was submitted to the states for ratification—having been passed by the Senate on the 5th and the House on the 12th—the sixteenth amendment to the Constitution, which (if you have forgotten) legalizes a federal income tax (which you haven't forgotten). On August 17 Alabama became the first state to ratify the new amendment. And on November 11, the United States Navy selected a site for its new naval base in the Pacific: Pearl Harbor, Hawaii.

Happy New Year—1910, that is.

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Calling Mr. Anthony!

Every once in a while your editor gets a problem from a reader that is a real puzzler, but even so, things are much improved over what they were years ago, if this letter, recently discovered tucked away in an old volume of our library, is any criterion:

Fargo, N. D.
July 6, 1911.

Dear Sir:

In the Metal Industry of June 1909 you described metallizing flowers. I am very much interested in the art of metallizing and have tried the method you described without success and have tried it a number of other ways. I have been trying to metallize grasshoppers. After dipping the articles in solution No. 3 it soon becomes colored from the shellac which is dissolved from the grasshoppers and if they are only left in No. 3 solution a short time they have spots that do not cover with silver. I thought perhaps the shellac was spoiling solution No. 3. I have had a few grasshoppers that seem to be covered perfectly with silver but for some reason they do not plate successfully only in patches. I will appreciate it very much if you will assist me in my efforts, at your earliest convenience.

Sincerely yours,
A. A. N.

(I wonder if anyone suggested that step No. 1 in the process was to be sure that the grasshopper was dead?)

Silver Plating on Nickel Silver

Question: We have trouble with our Silver plating peeling from nickel silver base metal, although other metals carried thru the same cleaning and plating cycles seem to come out all right. What is the trouble?

C. I. L.

Answer: Poor adhesion of deposits usually stems from improper cleaning. Nickel silvers are generally more resistant to acid attack than other copper base alloys, therefore I would suggest a stronger acid dip prior to plating. A dip in moderately strong solution of Sodium Cyanide just prior to your silver strike would also be helpful.

Hard Chrome on Stainless Steel

Question: Can you give me a cycle for hard chrome plating on chrome nickel stainless steel?

P. B. G.

Answer: A good cycle would be as follows:

After thoroughly degreasing, preferably in a chlorinated type solvent, the parts would be treated as in this manner:

1—Cathodic clean in an alkaline cleaner of about 16 oz./gal. at 180° F, 6 volts, for about ½-1 minute.

2—Etch for 15-30 seconds in Chromic Acid (28 oz./gal.) or in 50% muriatic acid, at room temperature. Longer treatment may be required for heavy chrome deposits over .001".

3—Rinse well, and chrome plate in the usual manner for hard chrome.

Nickel Plating Control

Question: I am having trouble with my nickel solution. I have been adding ½ oz./gal. single nickel salts and ½ oz./gal. nickel chloride every Saturday. Stirring up the tanks and then letting them settle and be ready for Monday. When dark streaks show up I add about 2 oz. of table salt. I believe the local water may be causing this trouble. Can you help me out?

J. L. M.

Answer: Ordinarily, water does not cause any trouble when used to make up plating electrolytes, unless it is excessively high in mineral or organic matter. It is apparent that you are not having a regular chemical analysis made of your solution. This has been proven to be the best way to maintain solutions in good working order, and well worth the few dollars that it will cost. A regular check on the constituents of your solution, plus periodic filtering, will enable you to get consistant results.

Electropolishing Lead

Question: Can you give me the formula for solutions for electropolishing Lead?

A. J. A.

Answer: Several solutions have been developed for electropolishing Lead.

No. 1

Perchloric Acid	30-34%
Glacial Acetic Acid	66-70%

Operate at 1.3-1.6 amps per sq. ft., at 68° F. Time required about 5 minutes.

No. 2

Caustic Soda 10% aqueous solution

Operate at .2-.4 amps per sq. ft., at 68° F. for 5-10 minutes.

Both of these solutions are the subject of patents, and the use of these formulas is governed thereby.

Standard Hardware Finishes

Question: Can you furnish us with detail of how to produce the finishes specified for builder's hardware, such as "U. S. #3 Polished Brass" etc?

H. A. S.

Answer: The finishes to which you refer are a part of Commercial Standard CS22-40 of the U. S. Department of Commerce. A set of samples illustrating the various finishes may also

be obtained from the same source. No attempt is made to tell how the finishes are to be produced, as there are a great many ways of duplicating them. I would suggest that you obtain a set of these standard samples and work out your own sequence of finishing operations.

Immersion Tin Coatings

Question: Can you give me a solution formula for producing an immersion tin plate on cast iron?

E. W. A.

Answer: The following method has been used to produce the type tin coating that you are looking for:

Solution

Tin Chloride	½ oz.
Aluminum Sulfate	2 oz.
Cream of Tartar	2 oz.
Water	1 gal.

Operate bath at 195-200 F. Time of immersion varies from 30-45 minutes. Parts are placed, after proper cleaning, in steel wire baskets, with small pieces of zinc sheets placed throughout the load in contact with the cast iron parts. The coatings are usually bright and uniform, but very thin.

Silver Plating Stainless Steel

Question: I have trouble in silver plating stainless steel knife blades with the silver peeling off. Can you suggest a remedy?

R. T. T.

Answer: Your trouble is undoubtedly due to improper cleaning and preparation of the surfaces prior to plating. I would suggest an electroetching in chromic or muriatic acid, then a flash coat of copper before the silver strike to promote better adhesion.

Using Silver Nitrate in Baths

Question: I would like to try using Silver Nitrate in a new silver solution I am making up. Can you tell me the exact amounts of this salt to use when substituting it for the silver cyanide. The silver cyanide needed for making up the solution is 3.2 oz./gal., and I want to have 2.5 oz. free cyanide.

R. A. B.

Answer: When substituting silver nitrate for silver cyanide, the ratio of their molecular weights is used. In this case it is 170/134, which means that we have to use 170 parts of silver nitrate to give us the same amount of metallic silver as is contained in 134 parts of the silver cyanide. Therefore we would have to use 4.06 oz. of silver nitrate in this formula instead of the 3.2 oz. of silver cyanide. In order to have 2.5 oz./gal. of free cyanide, you would have to dissolve with the silver nitrate 4.8 oz./gal. of sodium cyanide.

Colored Chrome Plating

Question: We have heard recently of a colored chrome plating process and would like to obtain details of how it works.

W. B. F.

Answer: We are at a loss as to what you mean by colored chrome plating. Perhaps you are referring to the mechanical process called "coloring" or "color buffing" after chrome plating to bring out the full luster of the deposited metal. This is very similar to ordinary buffing, except that finer compounds and softer wheels are used. To the best of our knowledge there is no process for producing colored deposits direct from the chrome bath.

Combination Gray and Bright Finish

Question: We are submitting herewith a sample part which we would like to have information on. How is this combination of gray and bright finish produced, and what is the plated metal?

K. G. M.

Answer: The plated metal is chromium. The combination gray and bright finish is produced by plating over surfaces that have been buffed bright in certain areas only before plating. No doubt a mask was used to protect the surfaces which appear gray during the buffing of the remainder of the surface. When the part is then plated, those areas which were not buffed bright will appear gray, as this is the natural color of the plated metal on dull or unbuffed surfaces.

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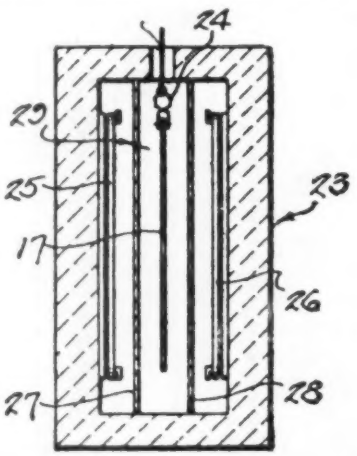
Patents

Conductive Coating on Glass

U. S. Patent 2,429,420. *Harold McMaster, assignor to Libbey-Owens-Ford Glass Co.*

The method of producing an electrically conducting coating on vitreous substances, which comprises

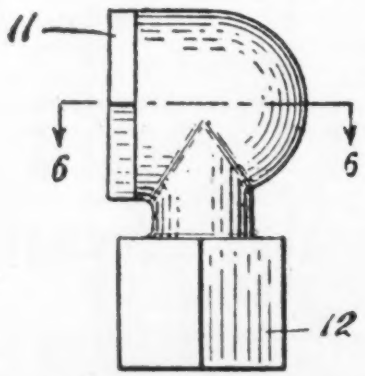


treating the vitreous substance by first heating the same and then dipping it while hot in a liquid including anhydrous stannic chloride containing chlorine dissolved therein and alcohol.

Spray Nozzle

U. S. Patent 2,429,267. *Charles R. Keep, assignor by mesne assignments to Westinghouse Electric Corp.*

A spray nozzle having an inner whirl chamber with a wall converged at the opposite ends thereof, said wall having an outwardly diverging outlet



formed therein, said nozzle having a liquid supply passage with a wall connecting substantially tangentially with a wall of said chamber whereby the liquid entering said chamber is given a spin, and means forming an inner nozzle in said whirl chamber, said means being positioned to extend crosswise of the whirl chamber and to form a partition across said passage for dividing the flow therefrom into two streams, one into said diverging nozzle and the other into said inner nozzle, said inner nozzle having an outlet aligned axially with said outlet and spaced therefrom.

Electroplating Nickel

U. S. Pat. 2,426,416. *Ernest W. Schweikher, assignor to E. I. du Pont de Nemours & Company, August* 26, 1947.

An aqueous nickel plating bath comprising:

	Grams per liter
Nickel chloride	225 to 275
Nickel sulfate	15 to 60
Boric acid	45 to 60
Metasulfobenzaldehyde	4 to 10

Air Circulator and Purifier

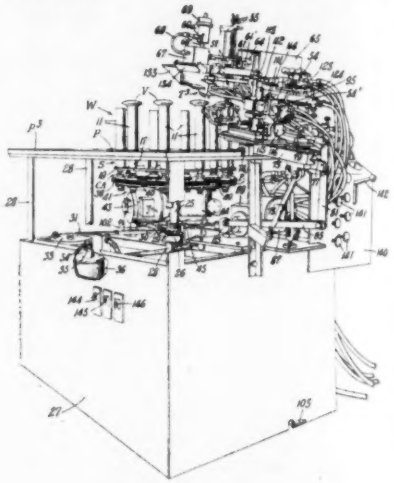
U. S. Patent 2,431,724. *Arthur E. Aydt.*

An air circulating device comprising a vertically elongated foraminous casing, a vertical shaft mounted in said casing for rotation on its axis, an electric motor in the lower part of said casing drivingly connected to said shaft, an updraft fan on said shaft above said motor for drawing air through the lower end of said casing from the region of the supporting surface on which said casing is supported and for driving air upwardly through said casing, sirocco blower means on said shaft above said updraft fan for projecting air radially outwardly through the sides of said casing a down draft fan on said shaft above said sirocco blower means arranged to further laterally disperse through the sides of the casing air rising through said sirocco blower means from said updraft fan.

Method and Apparatus for Applying Metal Coatings

U. S. Patent 2,431,781. *Robert L. Wagner, assignor to Haynes Stellite Co.*

Apparatus for applying a welded-on overlay of protective metal upon a surface of an article of revolution which surface is intersected by the axis of rotation of said article, which comprises means for supporting said article with said surface uppermost; means for rotating such support upon the axis of rotation of said article; means for directing each of a row of bodies of protective metal into contact with successive portions of said surface within an elongated welding zone upon said surface of the rtoating article while thus supported, said welding zone extending substantially from the axis of revolution of said article to an outer margin of said surface; torch means for directing welding flames upon the said surface within said weld-

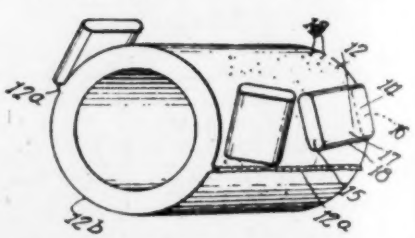


ing zone and upon the bodies of protective metal during the feed thereof; means for reciprocating said welding flames and said row of bodies of protective metal in unison along paths contacting said surface within said welding zone between said axis of rotation and an outer margin of said surface; and means for directing supplemental welding heat upon a surface of the article remote from said first-named surface.

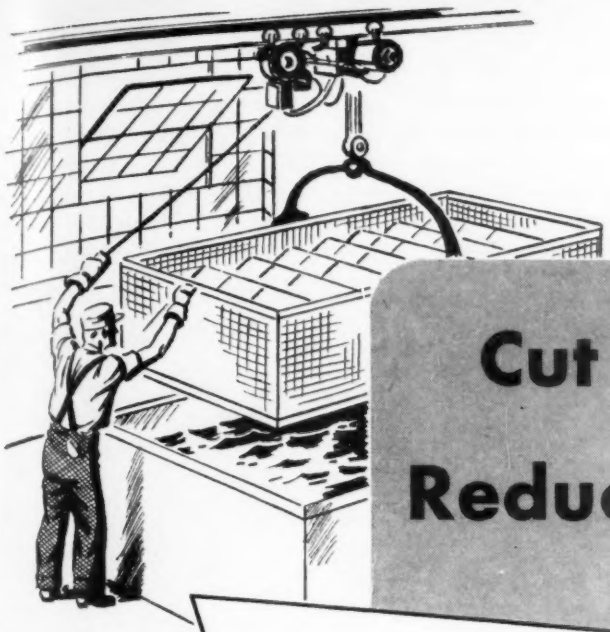
Material for Use in Tumbling Barrel Polishing Operations

U. S. Patent 2,431,870. *George E. Huenerfauth, Fred P. Green, and George J. Yochim, assignors to Crown Rheostat & Supply Co.*

An aggregate for use in the process



of tumbling articles to grind or finish the surface thereof, the aggregate comprising a mass of porcelain particles each having smooth surfaces some of



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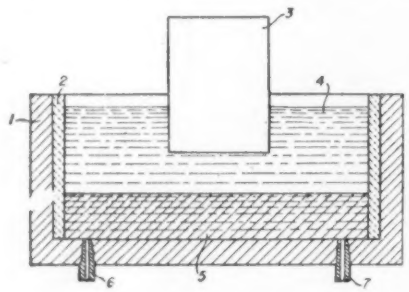
which are flat and intersect each other at right angles to provide sharp edges, the particles also having rounded surfaces and being free of sharp points and regular in shape.

Electrolytic Method for Producing Magnesium Alloys

U. S. Patent 2,431,723. *Leland A. Yerkes.*

A process which consists of subjecting to electrolysis a fused mixture of

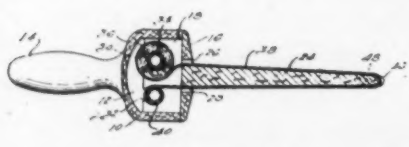


magnesium oxide, magnesium chloride and from 0.1 to 5.0% calculated as B_2O_3 of at least one boron compound, as a solubility promoter for MgO, selected from the group consisting of boron trioxide, boric acid, borax, borax glass, ulexite, boracite, colemanite and kernite, said electrolysis being carried out while employing as a molten metallic cathode at least one metal capable of alloying with magnesium, said metal being selected from the group consisting of lead, tin, zinc and bismuth, to produce an alloy of magnesium with said molten cathode metal.

Holder for Abrasive Material

U. S. Patent 2,430,060. *Wade Lamb and Carl W. Hood.*

In a holder for abrasive material, the combination of a housing having an open end and a handle portion, a cover for the open end of said hous-

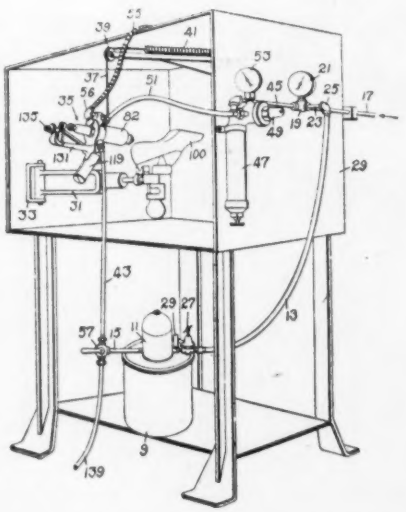


ing, a projection extending outwardly from the cover, having a pair of slots extending through the cover on opposite sides of the projection, a strip of abrasive material extending outwardly from the interior of the housing through one of the slots, said strip being supported on said projection and extending over the end thereof and back on the opposite side and thence into the interior of the housing through the other of the slots, a pair of rollers carried by said cover located within the housing, the opposite ends of the strip each being connected to one of said rollers, and means accessible from the exterior of the housing operable to rotate one of said rollers whereby said strip will become wound upon that roller to advance an unused portion of said strip into position upon the projection.

Method of Spraying a Temporary Protective Coating

U. S. Patent 2,431,684. *John J. Brophy, assignor to United Shoe Machinery Corp.*

A method of providing on a fabricated article a temporary protective coating, said method comprising treating a finely divided macromolecular film-forming colloidal substance with an unheated liquid which is a solvent

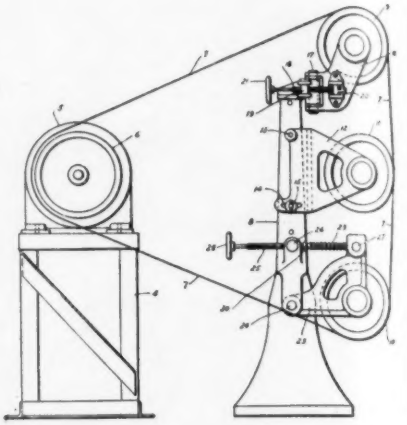


for the substance only at an elevated temperature to produce a pasty, nonsticky material, forming a moving column of said unheated non-sprayable material, heating the leading end only of the column to convert it into a free-flowing solution, causing a blast of gas to break the solution into a spray, and directing the spray upon the article.

Grinding Apparatus

U. S. Patent 2,431,795. *John A. Elmes, assignor to Walter L. Ryan.*

The combination with a driving pulley for an abrasive belt and a support for the pulley, of a pulley stand disposed forwardly of the support, pulley-supporting brackets on the stand, respectively at planes above and below the plane of the drive pulley, and projecting forwardly of the stand, guide pulleys on the brackets, in position to receive and guide the abrasive belt, means for adjusting one of the brackets about a vertical axis, to change the angularity of its pulley, means for adjusting the other bracket in a direction



to affect the belt tension, a back-up member for the belt, mounted on the stand at a point intermediate the two guide pulleys, and means for adjusting the back-up member relative to the normal path of the belt between the two guide pulleys.

Electroplating Silver on Aluminum and Its Alloys

U. S. Patent 2,430,468. *Edward M. Julich and William A. Mehmel, assignors to Bell Telephone Laboratories, Inc.*

The method of silver plating a predominantly aluminum body which comprises anodizing said body by utilizing said body as an electrode, immersing the electrode in an electrolyte consisting essentially of an approximately three per cent aqueous solution of phosphoric acid, subjecting the electrode to an alternating current for a time sufficient to form an adherent anodic coating on the surface of said body while maintaining said electrolyte at a temperature between about 70 degrees F. and about 75 degrees F. and while maintaining the current density at a value not exceeding about six amperes per square foot, and subsequently electro-depositing silver on said body by utilizing said body as a cathode in a silver plating bath consisting of an aqueous solution containing about 1.5 ounces of a silver alkali cyanide per gallon and about 6 ounces of a free alkali cyanide per gallon, without substantial alteration of said anodic coating prior to immersion in said bath.

Engineering Information Useful In Designating Metallic Surface Treatments

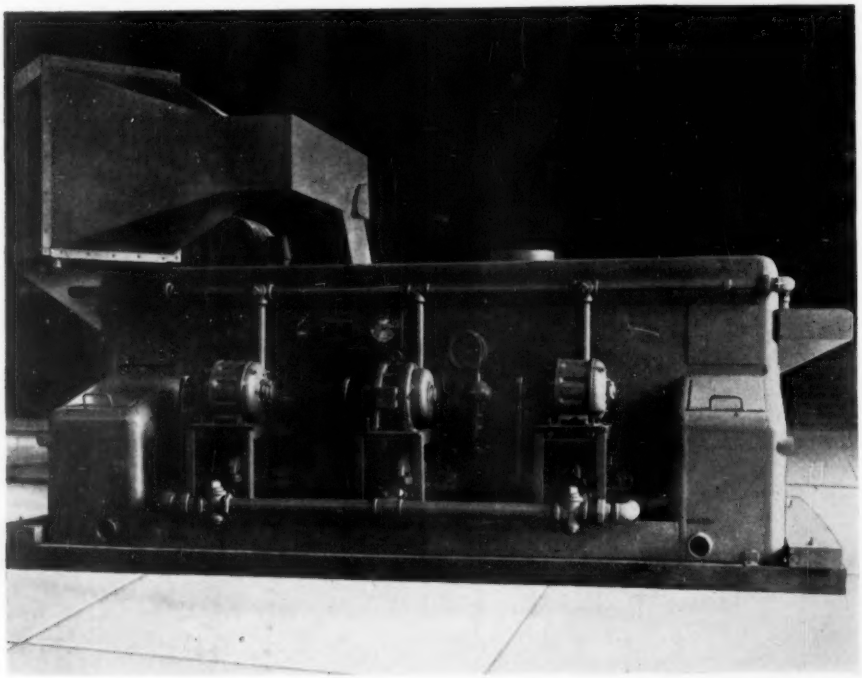
Engineering Data Sheet

Chemical Surface Treatments for Magnesium

TREATMENT	CHROME-PICKLE	DICHROMATE	ANODIZING
PURPOSE	Primarily to protect during storage and shipment. Can also be used as bonding treatment before painting.	Provides a salt water resisting coating, as well as a surface giving maximum paint adhesion.	To produce relatively heavy protective coatings on magnesium alloys that will resist severe corrosion and abrasion.
PROPERTIES	Low electrical resistance. Color varies from gray to yellow-red, depending on alloy and treatment.	Color of the coating will vary from dark brown to black, depending on alloy and treatment. Coating is rather soft, and painting should not be delayed any longer than necessary.	High electrical insulating properties are characteristic of these coatings. Coatings are considerably harder than the metal surface. Color of the coatings varies from gray for the AC type to yellow-brown for the DC types.
ADVANTAGES AND DISADVANTAGES	Brush application for articles too large to immerse in tank. Treatment removes approx. .0005-.0007 inches of metal, which must be taken into consideration on close tolerance surfaces. Removes oxides and old chemical finishes, as well as corrosion films.	Practically no affect on dimensions. Accurately machined parts may be treated. No electrical current needed, and coverage is good on odd shaped parts.	Provides maximum corrosion and abrasion resistance of all the chemical coatings. Coatings may be dyed a variety of colors similar to Aluminum alloys, but the dyes are usually not as resistant to fading as on aluminum. Coatings produced by the AC process are approx. .0004 in. thick, and by the DC process approx. .0008 thick.
PROCEDURE	Clean by usual methods, such as solvent degreasing, emulsion cleaning, etc. Dip in following solution: *Chromic acid* 1 *lb.* *Nitric acid* 1 *pint* *Water* *to make* 1 *gallon* *Temp.* 70-90 *F.* *Time* ½-2 *mins.* Rinse in cold then hot water, and dry.	Clean by usual methods, such as solvent degreasing, emulsion cleaning, etc. Dip in a 15-20% solution of Hydrofluoric acid at room temperature for approx. 10 mins. Rinse thoroughly in cold and hot water and dry. Boil parts for 45 mins. in a solution made by dissolving 1 lb. of Sodium Dchromate in a gallon of water. Rinse thoroughly in hot water and dry.	Either AC or DC current may be used. The solution* is as follows: *Sodium Hydroxide* 2 *lbs.* *Sodium Silicate* .028 *gals.* *Phenol* .03 *lbs.* *Water* *to make* 1 *gallon.* *Temp.* 170-190 *F.* *Time* *approx* 25 *mins.* *Current Density* *(DC)* 15 *amps/sq. ft.* *(AC)* 25 *amps/sq. ft.* *Voltage* 4-6 *volts* Thorough rinsing after processing is necessary. A weak solution of Chromic acid is used to neutralize the caustic soda remaining in the film.
NOTES	Solution can be kept in pure Aluminum, glass, or ceramic tanks. Draining for 5 secs. before rinsing improves color. Parts containing steel or brass inserts can be treated by this process, but polished steel surfaces should be protected. Coating may be sealed by treatment for ½ hr. in a boiling solution of Sodium Dichromate. Castings may require a short dip in 20% hydrofluoric acid before treatment in the pickle bath. Conforms to AN-M-12 Type 1 Specification.	Solution of Dichromate may be kept in a steel tank. Hydrofluoric acid should be kept in a rubber or lead lined tank. Parts having brass, bronze, cadmium, or steel inserts or assemblies can be treated without destruction. Aluminum is rapidly attacked. For wrought products a solution of 15% of Sodium or Potassium acid fluoride may be used in place of the Hydrofluoric acid. The time of treatment is then about 15 mins. Conforms to AN-M-12 Type 3 Specification. pH of the solution should be between 4.2-5.5.	Solution may be kept in steel tanks. Contact points of racks must be watched as the coating insulates the racks as well as the parts. Racks may be stripped in an acid pickle. The AC coating is more dense than the DC coating, but the DC coating is usually easier to dye various colors. The AC coating is considerably more ductile than an equivalent DC film. *Manodyz process, licensed by Hanson Van Winkle Munning Co. Other similar methods available using anodic oxidation reactions.

Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries



Rinsing & Drying Machine

Cincinnatti Cleaning and Finishing Mach. Co., Hecla St., Cincinnatti, O. Dept. MF.

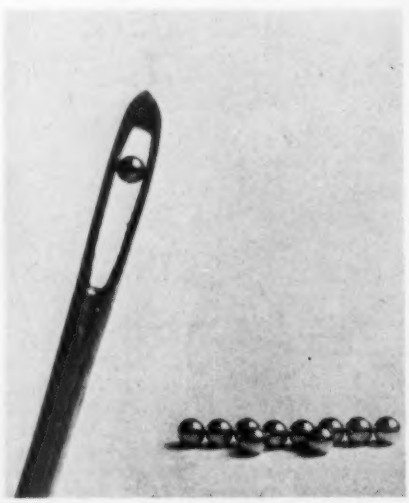
The drum type machine shown is designed for rinsing and drying parts after plating. Already used by several automotive and refrigeration companies in the midwest its savings in time and cost have gained widespread recognition, according to the above company. The parts after being loaded into a hopper at one end of the machine are cold rinsed, hot rinsed, and dried before being discharged. Either Standard or Custom built types for your specific requirements.

Extra-Small Steel Balls

New Hampshire Ball Bearings, Inc., Granite St., Peterborough, N. H. Dept. MF.

As an addition to their regular group of micro ball bearings, a newly developed line of extra small precision grade steel balls, in sizes 1 mm (.0394") and 3/64" (.0469") diameter, is announced by this company.

Although only about half the size of a pinhead, these high-carbon chrome alloy balls are held to a size tolerance of plus or minus .00005", and superfinished to a surface within 20 millionths of a perfect sphere. Their manufacture, involving gauging and inspection processes usually confined to the laboratory, has been brought to a production level.



Applications include anti-friction bearings, ball-pens, instruments, chemical processes and a variety of industrial uses.

Selenium Rectifier

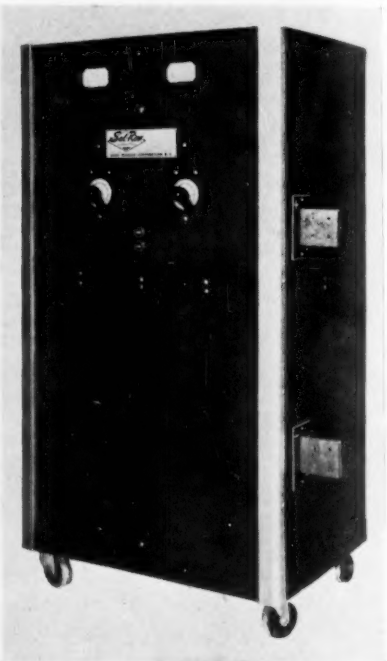
Bart-Messing Corp., 45 Morgan Ave., Brooklyn, N. Y., Dept. MF.

Recently announced by the above firm is a new 2500 ampere-9 volt selenium rectifier. Some of the most outstanding features are claimed to be:

1—Positive overload protection.

2—Selenium Rectifier stacks conservatively rated and triple coated for longer life.

3—Easier Installation. All installation connections are made externally thus reducing electrical installation costs.



4—Primary Transformer taps to compensate for abnormal line voltages.

5—Fan is only moving part. No external voltage needed to operate fan.

6—Magnetic Contactor.

7—Specially engineered heat-proof transformer—conservatively rated, designed to withstand high temperatures and corrosive atmosphere.

8—Lifetime Pilot Light.

9—Large Weston Meters (4½ inches square) clearly visible.

10—Tygon coated interior for protection against corrosion.

11—Positive protection against ven-

tilation restriction. Rectifier will automatically shut off if air intake is blocked.

12—Quick accessibility for cleaning unit and oiling fans.

13—Continuous Plating Control—permits changing tap switch positions without plating interruption.

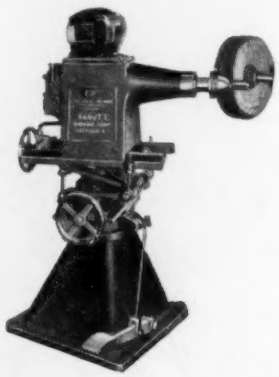
14—60 positions of adjustment—course switch—1 volt per step; fine switch ⅛ volt per step.

Dimensions: 72 high, 36 wide and 24 deep. Supplied complete ready for use on 200 to 480 Volts, 30-60 cycles.

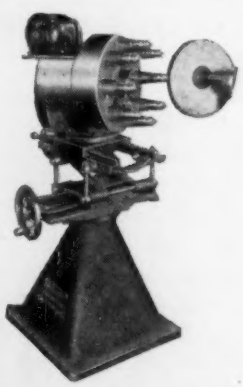
Automatic Buffing Machines

Vanott Machine Corp., Dept. MF, 216 Colgate Ave., Buffalo 20, N. Y.

This company announces a line of automatic polishing machines for use with present lathes that will increase production two or three times, it is



claimed. Many items now being done by hand can be chucked in these machines, the 8 spindle type handling work up to 3 inches in diameter and the single spindle machine taking larger pieces. The company also claims that finish will be improved due to the uniform pressure exerted against the wheel in their equipment, which eliminates the variation which is normal to all hand polishing operations. A 4 spindle type is also available for work up to 4 inches in diameter. In



order to prove its claims, the company will process sample parts for prospective customers, and give estimates of the savings made possible.

Improved Wrap-Rax Tape

The Hanson-Van Winkle-Munning Company, Dept. MF, Matawan, N. J.

Announcement is made by the above company that they are now in a position to supply their customers' insulating tape requirements with an improved Wrap-Rax masking and stop-off tape which will provide even greater thermal and chemical resistance.

Characterized by increased ease of handling, the new Wrap-Rax Tape may be rapidly applied after which it is heated to 300-325 F. to insure adhesion at each lap of the winding. However, many manufacturers have used the new Wrap-Rax without fluxing in cases where service conditions are not severe, for example, when using the racks in room temperature baths. When Wrap-Rax Tape is used in this way, the laps should be wider than usual, the wrapping tighter and the final lap, in addition to being cemented, should be tied down to insure retention of tension.

Using either of the above methods of application the new tape is said to provide complete protection for severe and mild service conditions, respectively, in all kinds of electroplating and anodizing solutions.

NEW UNICHROME RACK COATING

IT'S HERE

with 100% SOLIDS

IT'S READY for you now—Coating 218—the last word in rack coatings if you want a job that lasts, saves money and is quickly done. Here's why:

NO THINNERS! You get all *working* material in Coating 218. Nothing to evaporate, nothing to replace, no fire hazard.

FEWER COATS! Only *one* main coat is required over prime and "tie" coat. It goes on *smoothly* overall—in a coating that's far thicker than *eight* coats of solvent types!

QUICKLY APPLIED! Racks are ready in less than ¼ of the time ordinarily needed. You do the job in about 2 hours with Coating 218.

SUPER TOUGH! Elastic Unichrome Coating 218 won't tear or chip, blister or lift. This scuff-proof jacket stays sleek and smooth through toughest plating cycles!

Get the complete details. Write your nearest Unichrome office for our 4-page bulletin.

UNICHROME

Trade Mark Reg. U.S. Pat. Off.

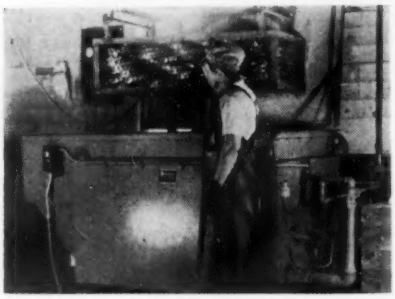
RACK COATINGS—Products of

UNITED CHROMIUM, INCORPORATED • 51 E. 42nd St., New York 17, N.Y.

Detroit 7, Mich. • Waterbury 90, Conn. • Chicago 4, Ill. • Dayton 2, Ohio • Los Angeles 11, Cal

Magnus 92K . . . A General Purpose Alkaline Metal Cleaner with Many Practical Advantages

Magnus 92K is a concentrated non-foaming *liquid* cleaner. Easy to make up in accurately proportioned solutions, instantly dispersed. No troubles with caking, lumping or soaking up water from the air. No unpleasant fumes or odors, either! It is ideally adapted to both mechanical washing machines and electrocleaning tanks, as well as still tanks. Safe for all metals, including the soft metals of diecastings, where ordinary alkaline cleaners cause much trouble and expense due to spangling, etching or corrosion. 92K is particularly effective in cathodic electrocleaning of zinc or aluminum.



Where you have dragover troubles, you'll find Magnus 92K to be most effective. It is much more freely rinsing than ordinary alkaline cleaners. (Run-off in the drainage interval between emergence from the cleaning solution and the rinsing stage can be made even more rapid and thorough by the addition to the cleaning solution of a few ounces of Magnus NXL, a special synthetic wetting agent.) For difficult cleaning on steel parts, 94K is recommended.

Of course Magnus 92K works unusually well in the Magnus Aja-Dip Cleaning Machine. Here its fast chemical cleaning action is greatly speeded up by the dynamic mechanical agitation provided by the machine. The solution is not moved around the work. The work itself is moved up and down IN the cleaning solution 70 or more times a minute. This swirling, pulsing, agitating effect not only speeds the cleaning action almost unbelievably, but also insures much better quality of cleaning. The use of this machine with 92K is particularly desirable in cleaning die castings and soft metals, because of its ability to shorten cleaning time and avoid the slightest danger of alkaline attack.

Magnus Chemical Company, 11 South Avenue, Garwood, N. J. In Canada—Magnus Chemicals, Ltd., 4040 Rue Masson, Montreal 36, Que. Service representatives in principal cities.

For Greatly Improved Micro-Finishes

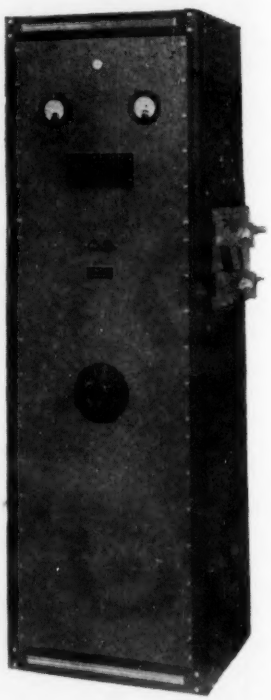
If you want a better grade of micro-finish on molds, gauges, tools, dies, precision parts or rolls, the technique of using Magnus Diamond Micro-Finishing Kits with "Color Code" is worthy of most careful investigation. Highest quality diamonds, meticulously graded, plus the unique Magnus system of color identification not only insures consistently duplicated micro-finishes, but ends your dependence on highly skilled personnel. With the Magnus Kit new operatives can quickly learn to do superfine work.

Write for Bulletin "Superfinishing."

Large Capacity Selenium Rectifier

Rapid Electric Co., Dept. MF, 2847 Middleton Road, Bronx 61, New York, N. Y.

Announcement is made by the above firm of the addition to their line of a



1,500 ampere selenium-type rectifier. The manufacturer claims that it is the only selenium rectifier that combines the following features:

1—A conservative output rating of 1,500 amperes at 6 volts.

2—A built in tapped switch output voltage control which varies the voltage over two-thirds of its maximum output.

3—A versatile dual-output combination. The 9,000 watts of the DC output power may be supplied at either 1,500 amps. at 6 volts, or 750 amps at 12 volts. This choice is made by a simple re-arrangement of the copper bars on the side panel.

4—Very accurately calibrated voltmeter 0-20 volts, and ammeter of 0-800 and 0-1,600 amperes. These meters read automatically on the correct scale depending on the bus bar arrangement.

The unit operates on 220 volt 50-60 cycle three phase current. The model number is TC1575, and further data may be obtained by writing the company.

Drying Small Parts

Belke Mfg. Co., Dept. MF, 947 N. Cicero Ave., Chicago 51, Ill.

Fast and efficient drying of small parts before and after electroplating is afforded by the Belke combination steam-heated sawdust barrel and sawdust separator, developed by the above firm.

The steam heated barrel dries the work leaving it bright, clean and free from water spots, according to the manufacturer. Steel ribs welded to the sides and bottom of the barrel assure positive tumbling action, allowing the sawdust to dry the work with a polishing action.

Tilting the barrel empties the work into the separator. Operating the separator sifts the sawdust into the convenient drawer below, leaving the clean work in the hopper. Tilting the hopper slides the work through the chute into a container.

Water Soluble Buffing Compounds

Special Chemicals Corp., Dept. MF, 30 Irving Place, New York City.

The above firm announces their introduction of water soluble buffing compounds. At present, there are four main products; A *Red Rouge* which is used for color buffing on gold, silver, and other precious metals; a *Yellow Gold Brush Compound* used for bristle brush work on gold; a *Wine Cut Compound* used for cut buffing on gold silver, and other precious metals. This compound is similar to the Yellow Gold Brush Compound but dryer. It gives a burnished cut (high lustre) rather than a scratch cut and burnishes the gold over rather than remove the metal, it is claimed.

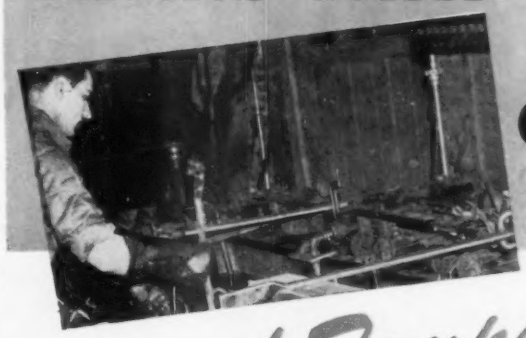
The fourth is a stainless steel compound for cut buffing on stainless steel. Strictly speaking, these compounds are water dispersed. This factor is of major importance in assuring removal of compounds from crevices. The compounds are removed from the crevices within two minutes in hot water at 140°F. it is said. Films of these compounds on polished work can be removed in cold water within 10 minutes, according to the above firm.

Corrosion Resistant Heat Exchangers

General Ceramics & Steatite Corp., Dept. MF, Keasbey, N. J.

Falls Impervious Graphite is a resin impregnated graphite with high mechanical and thermal shock resistance. It is inert to most strong acids and alkalies with the exception of oleum, hot nitric over 10%, and chromic acid. Standard Falls Impervious Graphite equipment includes plate heaters, both vertical and horizontal, 7 tube heat exchangers, concentric tube heat exchangers, and pipe and fittings. It is recommended specifically for heating pickling tanks, muriatic acid absorption plant units, chlorinatd hydrocarbon condensers and hydrofluoric acid absorbers, and generally for all applications involving the handling of corrosive agents where the choice of a material of construction has been difficult. Due to its extremely high thermal conductivity (overall values of 80-800 are not uncommon), it is ideally suited for heat exchange apparatus.

TANKS THAT *Thrive* on CHROMIC ACID at..



High Temperatures

... and in addition, take nitric and all other inorganic acids (except hydrofluoric), most organic acids — and oils and solvents — in their stride.

The tank pictured is a steel shell with ZEROK* Atlas resin lining, protected with 4" of acid-proof brick joined with VITREX, a special Atlas cement for temperatures up to 1600° F. and immune to any acid concentration.

Where floors, tanks, towers, stacks, ducts, drains, neutralizing and disposal pits, etc., must be *proof* against—not merely "resistant to" acids, alkalis, solvents, steam, water and high temperatures—Atlas Construction meets the situation satisfactorily *and permanently*.

Atlas furnishes materials and service, including design, supervision and installation, if desired. Atlas engineers will be glad to make recommendations on your problem, and to supply plans and estimates without obligation. Contact nearest branch—and write us at Mertztown for Technical Bulletin T1-D.

**ZEROK is proof against chromic, nitric and other strong acids, also against alkalis. It is available also as a paint, applied with brush or spray.*

The Atlas Mineral

PRODUCTS COMPANY OF PENNA.
MERTZTOWN PENNSYLVANIA

*ATLANTA 3, Ga., 452 Spring St., N. W.
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*DETROIT 2, Mich., 2970 W. Grand Blvd.
NEW YORK 16, N. Y., 280 Madison Ave.
PITTSBURGH 27, Pa., 4921 Plymouth Rd.
PHILADELPHIA, Pa., 335 Fairview Rd. Springfield, Pa.
ST. LOUIS 8, Mo., 4485 Olive St.

THE ATLAS MINERAL PRODUCTS CO. OF TEXAS, INC. Box 252, Houston 1, Texas
DALLAS 5, Tex., 3921 Purdue St.
*DENVER 2, Colo., 1921 Blake St.
*HONOLULU 2, Hawaii, U. S. A., P. O. Box 2930
OMAHA, Neb., 422 South 38th Ave.
*KANSAS CITY 2, Kan., 1913 Tauromee Ave.
*LOS ANGELES 12, Cal., 172 S. Central Ave.
NEW ORLEANS 12, La., 208 Vincent Bldg.
*SAN FRANCISCO 3, Calif., 244 Ninth St.
*SEATTLE 4, Wash., 1232 First Avenue, S.
*Stock carried at these points.

IN CANADA: Atlas Products are manufactured by H. L. BLACHFORD, Limited, 977 Aqueduct Street, Montreal, P. Q., 86 Bloor St. W., Toronto, Ont.

Business Items

Hennessy Named Sales Manager in Pittsburgh by Penn Salt

The appointment of *William J. Hennessy* as Pittsburgh District Sales Manager for the *Special Chemicals Division* of the *Pennsylvania Salt Manufacturing Company* has been an-

Filter All Plating Solutions Faster, More Completely in

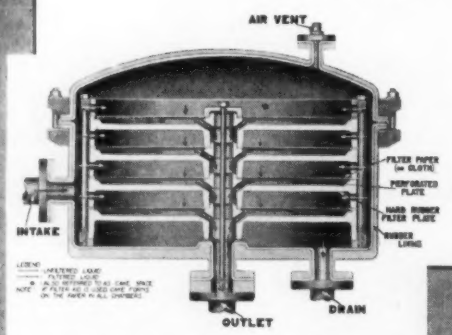
SPARKLER
Horizontal Plate
FILTERS

Because the filter cake is held horizontally, it is absolutely stable to the end of each filtering cycle. And cycles are longer because the cake retains its porosity longer. That is why the "horizontal principle," as embodied in Sparkler filters, gives you more efficient, low cost, operation. Sparkler filters are pressure-tight and leak-proof, designed for intermittent or continuous operation.

4 Plating Solution Types

1. Rubber-lined for bright nickel
2. Stainless steel for acids
3. All Iron for alkaline solutions
4. All Steel (with Stainless Pump) for chromium

SPARKLER MANUFACTURING CO.
Mundelein, Illinois



Made in Capacities
60 to 10,000 G.P.H.

See your supplier or Write for details

Our Engineering Service is available for any specialized problems.

nounced by *Joseph J. Duffy, Jr.*, Manager of sales.

A graduate chemist from St. Joseph's College, Mr. Hennessy joined Pennsalt in July, 1935. After several years' experience in manufacturing operations at the Greenwich plant in Philadelphia, he joined the Special Chemicals Division as a salesman in June, 1939.

As head of the Pittsburgh District, Mr. Hennessy will supervise special chemicals sales operations in the Pittsburgh, Cincinnati, Cleveland, Buffalo and Altoona Territories.

Mr. Hennessy is president of the Pittsburgh branch of the *American Electroplaters Society*. Mr. and Mrs. Hennessy and their four children reside in Glenshaw, Pa.

Nickel Prices Reduced

Robert C. Stanley, President of *The International Nickel Company, Inc.*, announced a reduction of 1¼c per pound in the Company's price for refined nickel in the United States.

The reduction becomes effective January 1, 1948, simultaneously with a like reduction in the United States import duty on refined nickel provided for in the recently signed reciprocal trade agreement between the United States and Canada.

Effective January 1, 1948, the new United States contract price for 99.9% electrolytic nickel from the Port Colborne, Ontario, refinery will be 33¾c per pound instead of the present price of 35c per pound.

Rinker Joins Bart-Messing Corp.

Mr. Morris M. Messing, president of *Bart-Messing Corp.*, 45 Morgan Ave., Brooklyn 6, N. Y., manufacturers of

Edwin C. Rinker

"Sel-Rex" selenium rectifiers, has announced the appointment of *Mr. Edwin C. Rinker*, as director of sales and engineering for the state of New Jersey.

After graduating from Pratt Institute in 1929, as industrial chemical engineer, Mr. Rinker joined the Yonkers, N. Y., division of *Otis Elevator Co.*, where he was in charge of control of chemical finishes, electroplating solutions and other chemical treatments.

From 1930 to 1936, Mr. Rinker was assistant to the department head of the Electrochemical Laboratory of the *Baker Co.*, Newark, N. J., where he conducted research and improvement on existing electrolytes of precious metals (palladium, platinum, gold, rhodium) resulting in development of new electrolytes for same.

From 1936 to 1945, while associated with *Oakite Products*, New York, he carried out development work on detergents used in the electroplating industry and assisted in development of detergents for other industries.

During this period, Mr. Rinker was on special service with the *Kellex Corporation* at the request of the U. S. Government, assuming a key position in the Manhattan Project.

Eaton-Clark Changes Name

Eaton-Clark Company of Detroit, Mich., with Canadian plants at Windsor and Toronto, has changed its corporate name to *Eaton Chemical and Dyestuff Company*, as announced by its President, *Berrien Eaton*. The

change became effective January 1, 1948, when the Company celebrated its one hundred and tenth anniversary.

Eaton Chemical and Dyestuff Company are manufacturers and distributors of Industrial Chemicals and Aniline Dyes.

Business was carried on under the name of *Theodore H. Eaton* from 1838 through 1865; as *Theodore H. Eaton and Son* from 1866 to 1910; and as *Eaton-Clark Co.* from 1911 through 1947.

There has been no recent change in the officers of the company and none is contemplated at this time. Berrien Eaton continues as President and Treasurer. *Richard C. Hedke* continues as Vice President, Managing Director and Secretary.

Rotheus P. Cole continues as Chief Chemist and Manager, Dyestuff Division; *Gerald T. McCray* continues as Sales Manager, Industrial Chemicals Division; *Raymond F. McDonald* continues as Sales Manager, Laundry and Dry Cleaning Products Division, and Advertising Manager.

Rufus W. Clark, who had been Chairman of the Board since 1921, retired from active business and as a Director a year ago.

Gilbert Tramer Appoints Ruleff

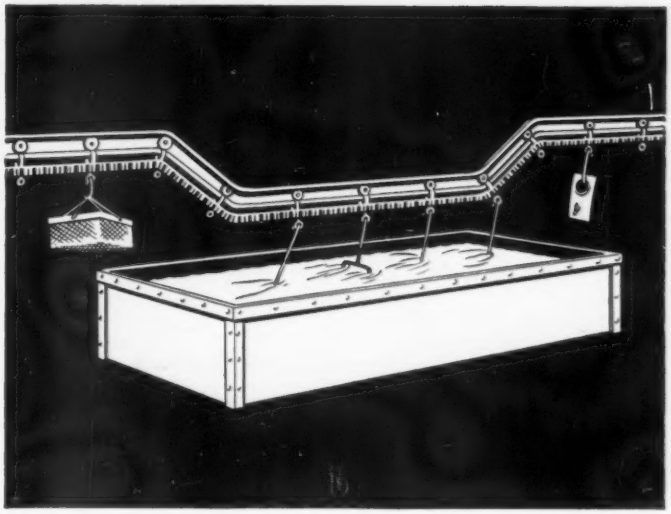
Mr. Robert Ruleff has been placed in charge of the Dayton Ohio office of the *Gilbert Tramer Company*, manufacturers of polishing and plating equipment, 402 Swetland Bldg., Cleveland 15, Ohio. The Dayton branch,

Robert Ruleff

which is located at 830 Gas & Electric Building serves the southern Ohio territory.

Mr. Ruleff is 28 years old, has a

save up to 50%



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EMLON SOLVENT-EMULSION

You get better and faster cleaning action, at lower cost, when you use this versatile new solvent-emulsion type cleaner. On actual production tests — due to the long life of Emlon solutions and the low concentrations at which Emlon is used — *savings of up to 50%* have been recorded.

Emlon is completely stable in hard water, and in acids and alkalies. It is free-rinsing and has anti-foam properties. Furthermore, it is non-flammable and nontoxic under normal conditions of use.

Ask your Wyandotte Service Representative about this unique metal cleaner and its many applications. Or write directly to us for a technical data sheet.

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WYANDOTTE CHEMICALS CORPORATION
WYANDOTTE, MICHIGAN • SERVICE REPRESENTATIVES IN 88 CITIES

CLEAN and SMOOTH

METAL PARTS COME OUT FREE OF GREASE OR CHIPS WHEN CLEANED IN A

BLAKESLEE

SOLVENT Vapor DEGREASER

Blakeslee Solvent Vapor Degreasers employ a patented degreasing process . . . parts made of metals and alloys chemically cleaned and dried in only a few seconds . . . no need for subsequent rinsing and drying operations. Oil and grease-free surfaces are obtained, complete oil removal from cracks, pores, seams and hidden crevices of machined parts, stampings, assemblies, etc., is assured. Masses of nested parts are thoroughly cleaned and dried throughout.

In this cleaning process, the oils and greases are dissolved by BLACOSOLV, the efficient degreasing solvent which can be used on all metals or combinations of metals. BLACOSOLV is non-inflammable and non-explosive.

Write today for FREE booklet on Degreasers and applications with Blacosolv, the all-purpose degreasing solvent.

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BLACOSOLV DEGREASERS AND SOLVENT

NIAGARA METAL PARTS WASHERS

G. S. BLAKESLEE CO., CHICAGO 50, ILLINOIS
NEW YORK, N. Y. TORONTO, ONT.

B.S. in Chemical Engineering from the University of Pennsylvania which he received in 1942. He is a member of the American Electroplaters Society, American Chemical Society and the American Society for Chemicals. Mr. Ruleff will continue the company policy of offering engineering and planning service on the installation of all polishing and plating equipment.

Buckeye Appoints New Chicago Agents

The Jacob Hay Company, 4014 *W. Parker Avenue, Chicago, Ill.*, is handling the complete line of Speedie Buffing and Polishing Compounds in Northern Illinois and Wisconsin according to an announcement by the *Buckeye Products Company, Cincinnati* 16, *O.*, manufacturers of Speedie Compositions.

The Jacob Hay Company is not only in a position to recommend the proper type of Speedie Composition for any type of buffing and polishing job but, to expedite deliveries, is maintaining in its Chicago warehouse a stock of Speedie Tripoli, Stainless Steel, Chrome, Nickel, Emery Cake, Grease Stick and Satin Finish.

In the Rochester, N. Y. area, Speedie Buffing and Polishing Compositions are handled by *Scobell Chemical Co.*, in the Detroit area by *A. T. Wagner Co.*, and on the West Coast by *E. B. Dunn Co.*, Los Angeles, Calif.

Wagner Brothers Appoints Goss

With their designation as Eastern Michigan distributors for *J. C. Miller* buffing compounds, *Wagner Brothers, Inc.* manufacturers and suppliers of metal finishing materials and equipment, have announced the appointment of *Ed. Goss* to their sales staff. Mr. Goss will handle sales of the J. C. Miller compounds, and buffs, grain, belts and other abrasive products distributed by the firm. Well-known in metal finishing circles, Ed. Goss has a record of 12 years' sales and production experience in the field of polishing and buffing materials.

Ed. Goss

Raybestos-Manhattan Appoints P. L. Edwards

Appointment of *P. L. Edwards* as assistant manager of its Central District Office in Pittsburgh, has been announced by *Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J.* Mr. Edwards, who has been manager of the Products Division of Manhattan's Western District Office, started with the Company 29 years ago as a clerk in the Chicago office.

Michigan Abrasive Elects Hauck

Frederick P. Hauck was elected vice president and director of *Michigan*

Abrasive Co. at a recent board meeting, *Max C. Jones*, company president, announced.

Hauck first was associated with Michigan Abrasive as a technical consultant. After several years in this capacity, he was induced to devote his full time to Michigan Abrasive Co. as Factory Manager in charge of production and research.

Born in New York City, Hauck received his elementary and high school education there. Then he enrolled in New York University where he gained a Chemical Engineering Degree.

Before coming to Detroit, he was associated with an Eastern abrasive manufacturing company, where he also was in charge of production and Research.

Baechlin Appointed by Illinois Testing Laboratories

Alfred C. Baechlin, 2033 *N. Fortieth Street, Phoenix, Ariz.*, has been appointed representative for *Illinois Testing Laboratories, Inc.*, 420 *N. La Salle Street, Chicago.* Mr. Baechlin will handle the complete line of Alnor scientific measuring instruments on an exclusive basis in Phoenix.

Pennsalt Changes Name of Acid-Proof Cement

The Pennsylvania Salt Manufacturing Company, Dept. MF, Philadelphia, Pa., announces a change in the name of one of its acid-proof cements.

The product formerly called *Asplit F* cement has been changed to *Pennsalt HF* cement. *Joseph J. Duffy, Jr.*, Manager of Sales of the Special Chemicals Division, explained the new name is more in conformity with other company named products, with the HF part denoting the cement's complete resistance to hydrofluoric acid in all strengths.

Pennsalt HF, a resin type cement, is one of eleven corrosion-resistant cements manufactured by the company.

Pagington Joins Special Chemicals

Mr. Edmund L. Pagington has been appointed sales representative for the *Special Chemicals Corporation*, 30 Irving Place, New York 3, New York and will operate mainly in the Metropolitan New York area.

He was a former member of the Providence Branch of the *American Electroplaters Society* and has had over 25 years experience in the electroplating trade having been with *Watson Company*, Attleboro, Massachusetts, *United Chromium Inc.*, Waterbury, Connecticut, and was sales representative for *Heat Bath Corporation* in New York City. Mr. Pagington is also a graduate of Brown University.

Kocour Distributors for MacDermid

W. D. MacDermid Co. Bristol, Conn. announces the appointment of the *Kocour Company* of 4800 S. St. Louis Ave., Chicago, Ill. as distributors for the states of Illinois and Wisconsin. All types of metal cleaning materials, together with solvents, lacquer and enamel strippers and various burnishing soaps and compounds will be carried at the Chicago plant of Kocour Company and will insure prompt delivery. The Sales and Service Engineer will be located in Chicago to assist the Kocour Company in service and sales distribution.

MacDermid has been appointed exclusive New England distributors for the *Midwest Mfg. Co.*, manufacturers of midwestern degreasing and washing machine equipment and will stock the Dow Chemical Company's tetrach-

PASTE

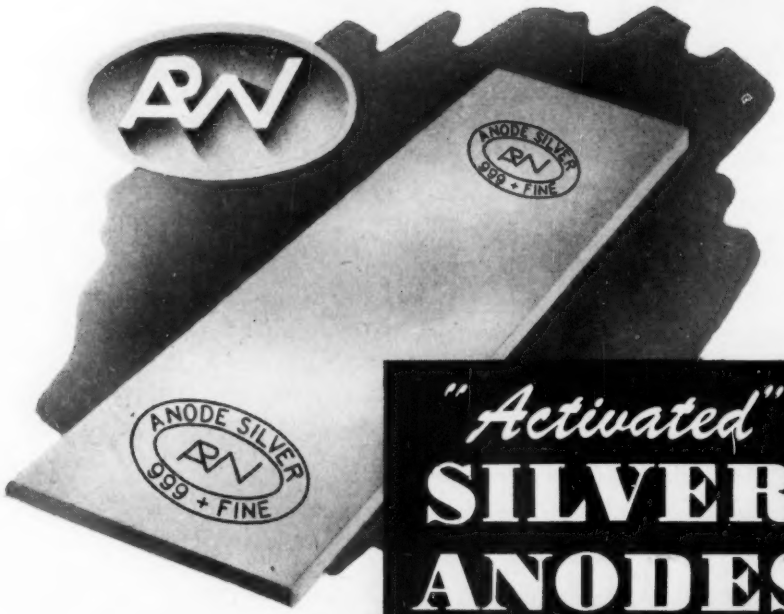
RACK INSULATION

No evaporation; not inflammable. All solids; no loss. Single coat gives thick and extremely tough coating which has long operating life.

SAVES LABOR—TIME—COST

New material. New method of handling. Requires baking to convert from Paste to solid. BUNATOL No. 1000 Paste Insulation has extra fluidity and handles fast without delays or trouble. Get the facts—prices.

NELSON J. QUINN COMPANY
TOLEDO 7, OHIO



"Activated"
SILVER
ANODES

Here's an improved anode that will give you CONSISTENTLY GOOD results in top speed silver plating.
APW "Activated" Silver Anodes are made from high purity silver under a special control of processing. They dissolve cleanly and evenly, with no impeding oxide film.
As a result of this high purity, there is a minimum of scrap, easier and better control of plating bath and cleaner, brighter, better plated products.

Already widely used by the silver plating industry, these improved anodes COST YOU NO MORE.

We invite inquiries for any quantity for prompt delivery.

Also
APW SILVER CYANIDE
80 ounce bottles
25 or 50 lb. drums.

THE AMERICAN PLATINUM WORKS
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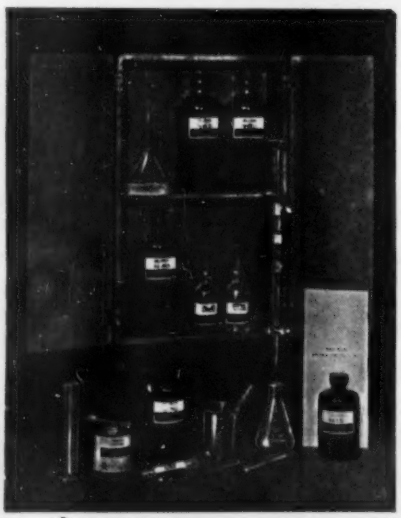

CHROMIUM
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Simple test sets for controlling these and other solutions available.

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KOCOUR CO.
4802 S. ST. LOUIS AVE.
CHICAGO 32

Specify Kocour Sets from your supplier.

lorethylene at their plant for prompt New England shipments.

MacDermid has also been appointed exclusive New England distributors for the *Peninsular Chemical Products Co.*, of Van Dyke, Mich. and likewise are carying substantial stock of all their materials.

Darco Appoints Gill

At a recent Board of Directors meeting the *Darco Corporation*, makers of

Louis M. Gill

activated carbon, appointed *Mr. Louis M. Gill* as company General Manager, and *Mr. Edgar W. Harris* as Director of Sales. The announcement was made public by *Mr. Isaac Fogg*, President of Darco.

Mr. Gill, who has been Director of Sales for Darco, first came with the company in 1923 as a salesman. He is a chemical engineer with a degree from Georgia Tech, and is a past Vice President of the *American Oil Chemists' Society*.

Mr. Harris, the new Director of Sales, has been with Darco since its formation, and has been in charge of sales to the sugar industry for some years. At the present time he is a Director of the Sugar Division of the *American Chemical Society*, and a member of the *International Commission for Uniform Methods of Sugar Analysis*.

Cohen Wintering in Florida

Emanuel Cohen, President of the *Cohen-Epner Co.*, 142 *West 14th Street, New York*, is spending the winter at Clearwater, Florida, recovering from ill health. His firm, which

operates one of the largest gold and silver contract plating plants in the U. S., has been in existence for 36 years. The management will be carried on without change in policy under the leadership of Mr. Cohan's lifelong associate, *Louis Epner*, Treasurer.

Manufacturers' Literature

Corrosion-Resistant Y and Angle Valves

A new bulletin released by *The Duriron Co., Inc.* of Dayton, Ohio, describes Durco corrosion-resisting, Series 35 Y valves and Series 36 Angle valves and shows their internal construction by means of cutaway views.

These illustrations bring out every construction detail and show, in color, exactly which parts of the valve are made of a special corrosion-defeating Durco alloy. Features are listed and a brief explanation of the type of service for which the valves are best suited, is given. The bulletin provides complete dimension data on the various sizes and includes an illustrated parts list.

The folder also tells how the valves can be equipped with air operated diaphragm motors for automatic regulation of the flow of corrosive solutions.

A free copy of this new bulletin can be obtained by writing to The Duriron Co., Inc., Dayton 1, Ohio, and requesting a copy of bulletin 615.

Shot Peening

American Wheelabrator & Equipment Corp., Dept. MF, Mishawaka, Indiana.

This edition of Shot Peening is the third since the book was originally published in 1944, contains all of the information included in the earlier editions plus the addition of comprehensive papers on the subject.

The book presents a review of the history of shot peening and includes a study of all literature on the subject as well as much original work by the authors, including a discussion of the use of shot peening for improving the fatigue strength of machine parts and the theory of fatigue failures.

The first portion of the book remains essentially the same as the second edition and is devoted to a study of the practical application of shot peening,

TODAY'S BEST BUY

for Setting Up POLISHING WHEELS AND BELTS

GRIPMASTER PATENTED POLISHING WHEEL CEMENT

LEADING PLANTS REPORT:

GRIPMASTER BOOSTS POLISHERS' PRODUCTION AN AVERAGE OF 47% MORE PIECES PER HEAD!

Now! **Longer Wheel Head Life!** Thanks to Gripmaster's special high-heat resisting ingredient!

Now! **Fewer Stops for Wheel Changes!** Gripmaster *locks in* grains of emery "vise tight!"

Now! **Inventories Simplified!** One grade grips *all* grains—300 to 20. No special sizer needed!

Now! **Better Finishes!** Greater flexibility gives more and finer "breaks" when wheel is "cracked!"

Now! **Goodbye to S. O.!** There's no Stockyards Odor in Gripmaster. It's clean, odor-free!

GRIPMASTER MEETS EVERY NEED

Gives astounding results on all metals—ferrous and non-ferrous. Ideal for plastics, too!

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Windsor, Ontario

☐ Send us a generous FREE SAMPLE of Gripmaster.
☐ Send us data on how to boost polishing production.
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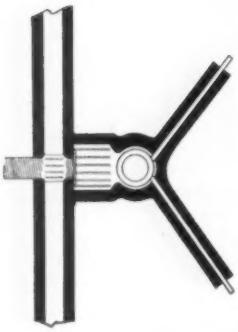
COMPLETE WITH CONTROLLING EQUIPMENT
THOROUGHLY RECONDITIONED & GUARANTEED
EXCELLENT VALUES WHILE THEY LAST

1—CHAS. J. BOGUE ELECTRIC CO. M.G. SET—40 KW, 5000/2500 Amp., 8/16 volts, 490 RPM, Twin Commutators, Sep. Exc. (220/3/60 Motor). PRICE $3250.00.
1—JANTZ AND LEIST M.G. SET—5000 Amp., 3 to 8 V, 430 RPM, Interpole, Sep. Exc. (220/3/60 Motor). PRICE $3450.00.
1—JANTZ AND LEIST M.G. SET—6000 Amp., 3 to 6 V, 430 RPM, Interpole, Sep. Exc. (220/3/60 Motor). PRICE $3450.00.
1—EAGER ELECTRIC CO. M.G. SET—5000/2500 Amp., 6/12 V, 490 RPM, Sep. Exc. (550/3/60 Motor). PRICE $3000.00.
1—EAGER ELECTRIC CO. M.G. SET—5000/2500 Amp., 6/12 V, 490 RPM, Sep. Exc. (220/3/60 Motor). PRICE $3000.00.
1—HANSON-VAN WINKLE CO. 4000/2000 Amp., 6/12 V, 490 RPM, (220/440 V Motor), Sep. Exc. PRICE $3000.00.
1—GENERAL ELECTRIC CO. 2000/1000 Amp., 6/12 V, 1200 RPM, (220/3/60 Motor). PRICE $1650.00.
1—HANSON-VAN WINKLE CO. 4000/2000 Amp., 3/6 V, 490 RPM, (550/3/60 Motor). PRICE $2250.00.

IMMEDIATE DELIVERY

M. E. BAKER COMPANY

143 Sidney Street — Cambridge 39, Massachusetts



RACKS IS OUR BUSINESS

We know racks. We make better racks. That's our business . . . better racks for electroplaters. We've made them scientifically for over nine years. And we make all kinds of racks for every kind of plating job.

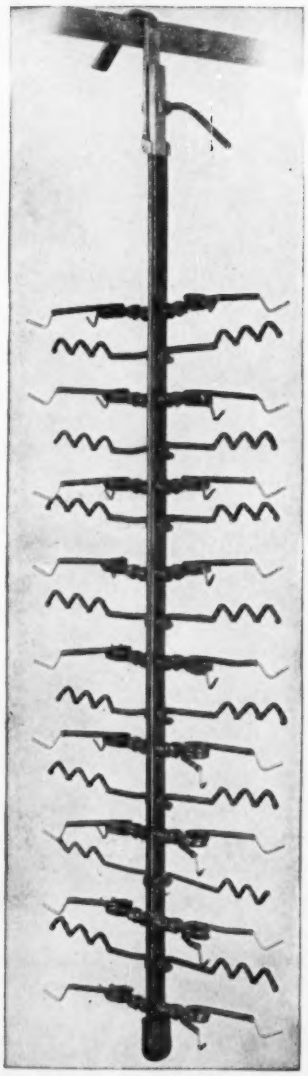
Here's an example. Standard Plating Rack Company makes the Du-All Universal Plating Rack. This is a single rack with a multiplicity of uses . . . an all-purpose plating rack offering platers the latest design in efficiency and economy.

The Du-All provides holding attachments that accommodate a wide variety of shapes and sizes. Adjustable for regular or specialized plating jobs. Permit practically all inside and outside plating requirements. Speed production. Cut costs.

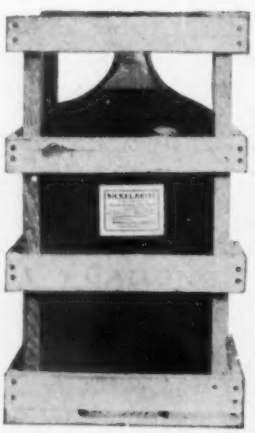
The Du-All has Stand-It-All Flexible Insulation. This insulation, featured on most of Standard's racks, prevents robbing of current . . . eliminates plating material loss. A perfect insulation in all standard solutions.

Another feature of this rack is the Du-All Anode Rack Attachment which insures efficient inside plating. And excessive current is no problem when the Du-All is used with the Insulated Octopus Feeder.

Scientific development has made the Standard Du-All Plaing Rack indispensable in your shop. All of our racks are constantly being improved through research. Specify Standard when ordering racks.



STANDARD
PLATING RACK COMPANY
1911-1925 North Paulina Street
Chicago 22, Ill.



Use NICKEL-BRITE
(REG. U. S. PAT. OFF.)
FOR NICKEL PLATING

"Nickel-Brite" eliminates color buffing and burnishing after plating. Indispensable for small work. "Nickel-Brite" works equally well in conveyors, plating barrels or still tanks—one-half pint required per 100 gal. nickel solution. Order today.

1 Gallon Bottles $5.00
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I-HEAL-U Ointment
For Cyanide Sores

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TRIAL OFFER — NO RISK
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WAMBAUGH CHEMICAL CO.
1005 S. 9th — GOSHEN, INDIANA

with particular emphasis given to the methods of handling the work and controlling the quality of the operation. The second part of the book discusses in considerable detail the theory of fatigue and how it is affected by shot peening.

This attractive, 181-page book is nominally priced at $1.50 but will be sent without charge to interested executives who send in their requests on company letterhead.

Dust and Fume Eliminators

Schmeig Industries, Dept. MF, 380 Piquette Ave., Detroit, Mich.

12-page bulletin on Centri-merge Swirl Type dust and fume eliminators. Sectional views showing the principle of operation of these devices are given, as well as photographs showing typical installations. Engineering data on the various sizes from 400 cfm. to 30000 cfm., including dimensions, is effectively illustrated.

Water De-mineralizer

American Cyanamid Co., Ion Exchange Dept., 30 Rockefeller Plaza, New York, N. Y.

Because of the profound effect of small amounts of minerals in the water used in some industrial processes, the production of chemically pure water in large quantities and at low cost is a matter of extreme importance. The above firm has developed materials and equipment which make it possible to eliminate costly distilled water for these critical processes. The materials are called "ion exchange resins", and equipment utilizing these resins is available for de-mineralizing water in quantities up to 1,000 gallons per hour. Larger sizes can be made to special order. Installation of the equipment is claimed to be very simple, requiring only connections to the water supply line, drain, and electrical power outlet. Control is completely automatic and adjustable to various degrees of purification. Other possible uses for this process are recovery of precious metals from rinses and the treatment of waste liquors.

Bulletin on "Filt-R-Stil" may be obtained by writing to the above address.

Contour Grinding

Porter-Cable Machine Co., Dept. MF, 1714 North Salina St., Syracuse 8, N. Y.

The two-color, 8-page bulletin C-6 states the principles of contour grind-

ing as well as lists the benefits to be derived from this new method of polishing contoured pieces of work on an especially shaped wheel. Various models are shown with complete specifications. The bulletin is profusely illustrated by in-action photographs of various kinds of jobs performed by this method. The contour grinding method can be applied in any metal working shop where polishing operations are performed.

Wetting Agents and Surface Active Agents

Two new data sheets have been issued by the *Onyx Oil & Chemical Co.*, Jersey City 2, N. J. describing their Neutronyx series of surface active agents, and wetting compounds. These sheets are designated as Nos. 4-T and IND-1, 2, 3. Properties and performance data are given, as well as applications and uses. Copies are available by writing the above firm.

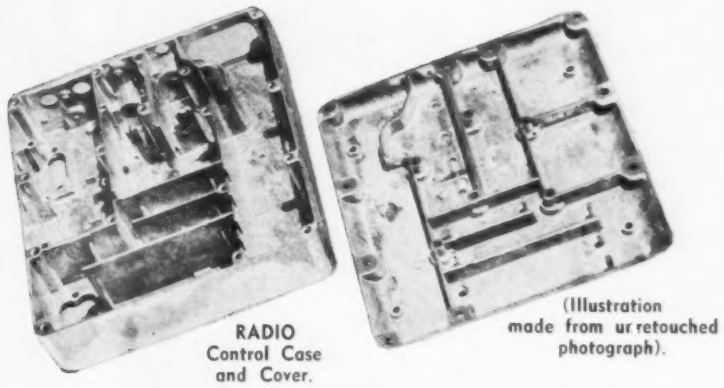
Courses in Electroplating

The Institute of Electrochemistry and Metallurgy, 59-61 East Fourth Street, New York City will offer specialized courses in the field of electroplating and metallurgy during 1947-48. Advancements made in the metal finishing field during the war years are covered. Veterans can attend the school under the G. I. Bill of Rights. Registration will be held for the Spring term from January 26 to February 2, and the first class will be held on February 3. Those interested should apply early as it will be necessary to limit enrollment in Electroplating II due to the large number of applicants for the course. The following studies will be offered:

SPRING COURSES

ELECTROPLATING II.

This course is designed to give the electroplater a knowledge of the ways and means of obtaining better deposits by applying the latest scientific methods of electrochemistry to electroplating. One hour of each evening will be devoted to a lecture on the theoretical aspects of the subject and two and one half hours will be spent in the laboratory where the student will apply the principles set forth in the lecture. Copper, nickel, zinc, cadmium,



RADIO
Control Case
and Cover.

(Illustration made from ur retouched photograph).

Intricate Die-Castings Cleaned with PERMAG

PERMAG Compounds *clean* the complicated die cast pieces which ordinary cleaners do not clean satisfactory. As an example, the Radio Control Case shown above has an involved system of cored bosses in which are holes and angles which must be cleaned prior to finishing. These places are difficult to reach and none but the most efficient cleaner could do this job. The proper PERMAG Compound is specifically adapted for cleaning die castings and does the work quickly and thoroughly. Whether you have just a plain die casting or a very complex one, PERMAG will clean it better.

Let us give you more details about PERMAG and its economical service. Write or 'phone, or have our representative call.

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DEPENDABLE FINISHING ROOM EQUIPMENT & SUPPLIES

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MODERN
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Strips Tin
Without Damage
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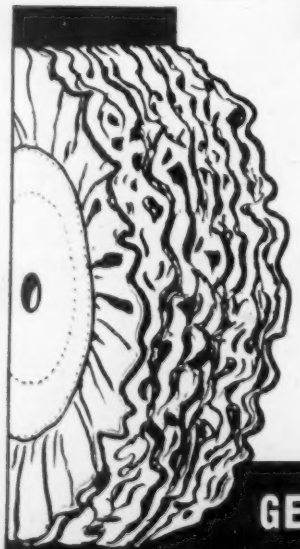

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on your
Buffing Costs
USE
CHURCHILL FINGER-BUFFS
— AIR COOLED —
Faster Cutting — Lower Costs
Sole Mfrs.

GEO. R. CHURCHILL CO., INC.
NO. QUINCY 71, MASS.
Under U. S. Patents Nos. 2146284, 2350216. Others Pending.

chromium, silver, and brass will be deposited from aqueous solutions. While plating the above metals, the factors governing the character of the deposit such as current density, temperature, pH, etc. will be noted. Other experiments will include throwing power, single electrode potential, addition agents, resistance of solutions, anodizing and coloring aluminum, corrosion tests, etc. After these are complete the students will prepare standard solutions and make analyses of all the important constituents of the above plating baths. Tuesday and Wednesday, 7:30-11:00 P. M. Prerequisite: Electroplating I. or its equivalent. Dr. Young, Mr. Klinse and Mr. Bundy. Fee $55.00.

METALLURGY II. (Metallography):

This course is designed to teach the student preparation of metallographic samples for microscopic examination. Various samples of different metals and alloys will be polished, etched, and examined under the microscope. The detection of faulty alloys and metals will be stressed. Dr. Young, Mr. Klinse and Mr. Bundy. Tuesday and Wednesday, 7:30-11:00 P. M. Fee: $35.00.

RESEARCH II:

This course is designed to gives the practical electrochemist a chance to investigate problems in his field. One half hour per week is devoted to a conference with the instructor in which the method of attack is laid out. The remaining time is spent in the laboratory where the student applies his knowledge and technique to the solving of problems which arise in such an investigation. Tuesday and Wednesday, 7:00-11:00 P. M. Dr. Young, Mr. Klinse and Mr. Bundy. Fee $40.00. Time payments may be arranged if desired.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

1948 Convention News!

The Newark Branch of the *American Electroplaters' Society* wishes to remind all its members and friends in the plating and allied industries that it will be the host to the 35th

Annual Convention which is scheduled to be held June 28, 29, and 30, and July 1, 1948, in Atlantic City, New Jersey.

Our general chairman, *Mr. Horace H. Smith*, who is well known and well liked throughout the industry, and his various committees are hard at work laying the ground work for the greatest convention ever held by the American Electroplaters Society in its entire history.

Only a short distance from the busy and highly industrialized metropolitan area of New York and New Jersey is one of the world's greatest convention cities. The Atlantic City auditorium, which will be the home of our industrial exhibit, has few, if any, equals in the world.

Atlantic City is the most beautiful seashore resort on the entire eastern seaboard. If there's a place on this continent where east meets west, and the twain brush elbows with America's great, that place is Atlantic City, host to the 1948 American Electroplaters convention.

The facilities for entertaining visitors for conventions, and tourists seeking to spend their vacations at Atlantic City are too numerous to mention. We, therefore, respectfully suggest that you attend the 35th Annual Convention, not only as a visitor and guest, but also as a vacationist to enjoy all that we and Atlantic City have to offer to you and your entire family. The Ambassador Hotel has been selected as the Convention Headquarters.

Detroit Branch

The annual Meeting and Banquet of the Detroit Chapter was held on December 6th, at the Statler Hotel, Detroit. A technical session and symposium of Plating Plant Engineering, was held in the afternoon, with Chapter President *Walter G. Pinner* presiding.

Papers were presented by the following speakers:

L. Moye, Engineer, The Utley Co.
G. L. Nankervis, Pres., the George L. Nankervis Co.
L. C. Borchert, Technical Manager, Houdaille-Hershey Corp.
V. P. John, Manager, Industrial Div., American Blower Co.
G. M. Cole, Chem. Eng., Fisher Body-Ternstedt Div., General Motors Corp.

After the technical session a discus-

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sion period open to all was conducted. A large amount of discussion followed, especially regarding Mr. Nankervis' paper on the use of aluminum bus bars, and also Mr. Borchert's "ground lights" for detecting stray currents. Reprints of all the above papers will be made available at a later date through the American Electroplaters Society.

Mr. Pinner introduced a distinguished visitor from England, *Dr. S. Wernick*, past president of the *Electrodepositors Technical Society*, and an eminent authority in the field of metal finishing, who spoke briefly on his observations of American finishing practices. Dr. Wernick also stressed the need for closer coordination of Anglo-American activities in this field in the future.

In the evening the annual banquet was held in the Grand Ballroom with approximately 1,100 members and guests attending. Many non-technical sessions were also in evidence throughout the evening.

Once again the Detroit Chapter has proven that it can promote a meeting combining a worth-while educational program with an equally satisfying proportion of good fellowship, and these annual sessions have become the high spot of the winter season for finishing men.

Rochester Branch

The regular monthly meeting of the Rochester Branch of the A.E.S. was held at the Hotel Seneca on Friday Nov. 21, 1947.

The business meeting was postponed until after the talk as courtesy to our speaker *Mr. Frank Smith*, president of *Technic Inc., Providence, R. I.* Mr. Smith's talk on "Gold and Gold Alloy Electroplating" was comprehensive and well presented. The Rochester Branch honored the guest speaker with an unusually large turn-out of over sixty members and guests. Some unusual features of precious metal deposition and the need of perfect preparation of the basis metal were emphasized.

The business meeting started with applications for membership by:

John M. Duford, E. K. Co. Camera Works; *Daniel Tauriello*, Hickok Mfg. Co.; *Oscar Kraft*, Hickok Mfg. Co.; *Harlow Shepard*, Hickok Mfg. Co.

Mr. *Cecil Thornton* was reappointed Chairman of the Research Committee

and will appoint his own committee.

The Joint Session with Buffalo, Toronto and Syracuse will be held in April at the Hotel Seneca. *Mr. William Tucker* was elected Chairman, *Joe Hull* charge of advertising, and *John Q. Adams* in charge of the Program Committee.

The Rochester Branch voted to admit Students in Metal Finishing at *Rochester Institute of Technology as members.*

Chicago Branch

The Annual Educational Session and Banquet will be held on Saturday, January 24th at the Stevens Hotel, Chicago.

The Educational Session will begin at 2:00 P.M., and will feature the following topics and speakers:

1. *"High Speed Copper Plating from Cyanide Solutions,"* by Merl Young, Electric Auto-Lite Company.
2. *"Operating Conditions for Rochelle and Cyanide Copper Plating Baths,"* by Dr. A. K. Graham, Exec. Sec'y, American Electroplaters Society.
3. *"Copper Plating from Fluoborate Baths,"* by Dr. M. M. Beckwith, Harshaw Chemical Company.
4. *"Characteristics of the Pyrophosphate Copper Plating Solution,"* by Dr. J. E. Starek, United Chromium Inc.

Following the Technical Session, the Annual Banquet will take place, starting at 7:00 P. M. Tickets for the Banquet are $7.50 per person.

Out-of-town guests should make hotel reservations as early as possible.

Melbourne (Aust.) Branch

The twenty-ninth regular meeting was held at the *Chamber of Manufactures* on the 24th of November. The usual lecture was replaced on this occasion by an informal *"Discussion on Old Time Plating"*, when *Mr. W. Hart* and *Mr. F. Quinton* were interviewed by *Mr. N. L. Carter.* These two gentlemen have been associated with the electroplating trade for many decades —Mr. Hart starting as an apprentice in England in 1879, while Mr. Quinton was found to be relatively a juvenile, having delayed his introduction to plating until just after the turn of the century.

Mr. Hart had a varied experience in England before coming to Australia in 1923, since when he has been associated with a well known manufacturer of electrical appliances; and, during

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the war years was in charge of the plating section of the Munitions Supply Laboratories at Footscray. Mr. Quinton commenced plating as a youth in Hobart, Tasmania, but transferred back to the mainland after several years, and has been a prominent member of the electroplating community in Melbourne for many years. Mr. Quinton was closely associated with the introduction of chromium plating in Australia, and both he and Mr. Hart are considered experts in this field.

Many of those present took the opportunity to ply questions and many interesting discussions ensued. Interest was shown in several very old plating books which were exhibited by Mr. Quinton; and when the meeting closed, it was voted unanimously one of the most interesting held during the year.

Los Angeles Branch

Fred C. Poulson, Southern California district manager for the *Porter-Cable Machine Co.,* described the Porter-Cable contour grinder and other abrasive units produced by that firm, as the principal speaker at the December 10 meeting of Los Angeles Branch of the *American Electroplaters' Society.*

Following his general discussion, Mr. Poulson presented a film entitled "A Machine of the Age," showing the uses and operation of the wet belt grinder. Poulson provided the explanatory commentary.

The Educational Session provided a lighter side also in the form of a film covering the highlights of the Louis-Conn and Louis-Baer fights.

Marcus D. Rynkofs, head of *Liberty Plating Co., Los Angeles,* who has held every office in the branch, including president and secretary, since he became a charter member in the early

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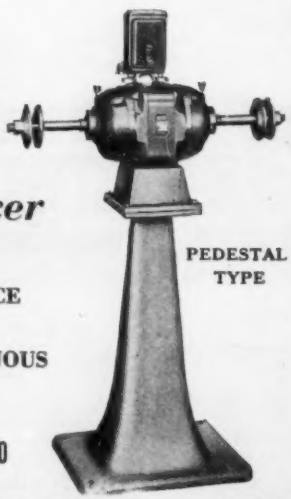

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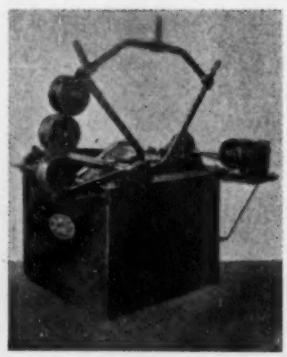

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1930's, and *Ernest Lamoureux*, one of the best informed men on A.E.S. matters in the country, were named by president *Howard Woodward* to serve as a committee to assemble the data and write a history of Los Angeles Branch, in compliance with a request for such data from the office of the executive secretary.

Initiated as new members of the branch were *George D. McDonald, Jr.*, of the *Hallenscheid-McDonald Co.*, and *Merl D. Pendlay* of the *Portland Plating Works*.

Guests introduced included: *William Nairn*, A. J. Lynch Co.; *Roy Churston*, Price-Pfister Brass Co.; *Mario Borrelli*, Modern Plating Co.; *Cecil Havens*, Bonnarjee Jewelry Co.; *Cal Snelgrove*, California Juvenile Products Co.; *Harvey G. Groehm*, Composite Die Supply Co.; and *A. C. Luechauer*, a member of Cincinnati Branch, A.E.S., now employed in the plating division of North American Aviation Co., Inglewood, Calif.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

The fourth annual Conference and Exhibition of the *National Association of Corrosion Engineers* will be held April 5-8, 1948, at the Jefferson Hotel, St. Louis, Missouri. The technical program will include symposia on Cathodic Protection, Chemical Industry, Communications, Electrical Industry, Gas Industry, General Industry, Oil Industry, Protective Coatings for Metals, Salt Water Corrosion and Water Industry, with papers by authoritive engineers. The Exhibition with displays by various manufacturers will show the latest in equipment, material and methods for combating corrosion. The Association's Annual Banquet will be held Wednesday evening, April 7th.

SOCIETY OF AUTOMOTIVE ENGINEERS

Nearly 50 technical papers on aircraft powerplants, diesel engines, trucks and buses, transportation and maintenance, aircraft, fuels and lubricants, tires, air transportation, production, materials, and related subjects will be presented at the SAE Annual Meeting and Engineering Display January 12 through 16, 1948 in Book-Cadillac Hotel, Detroit, Mich.

The program calls for engineering symposiums on problems of diesel engine smoking and reversing propellers, and for exhaustive discussions of modern requirements of fuels and lubri-

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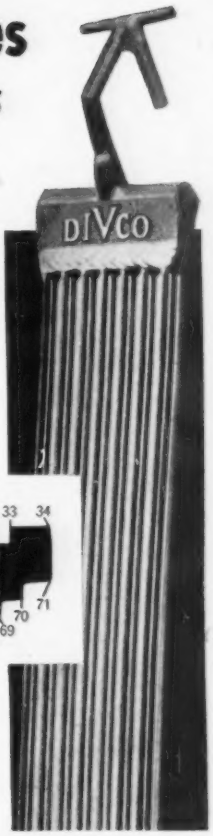
churn chrome plating solutions like a boat propeller—



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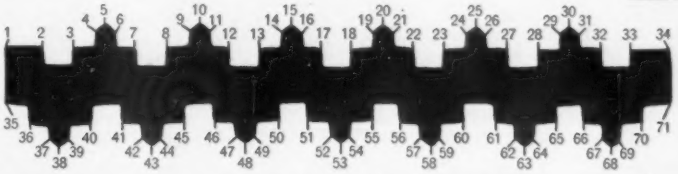
No wonder disintegration is uniform and Divco 71-Point Anodes retain their great efficiency throughout an exceptionally long service life.



Count the 71 throwing edges

This cross section shows why the patented 71-point design gives throwing power found in no other anode. *Still greater efficiency and convenience is afforded by the first cast copper hooks ever used on lead anodes.*

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cants. Newly-elected SAE officers for 1948 will be announced at the SAE Annual Business Session Tuesday evening, January 13. The SAE Annual Meeting Dinner will be held Wednesday evening, January 14, with *William Hazlett Upson* as guest speaker. Thursday, January 15, has been designated "Junior-Student Day." Engineering students will be guests of SAE Detroit Section at the day's technical sessions.

The tentative program follows:

Monday Morning, Jan. 12, Transportation & Maintenance Session: Chairman, *F. K. Glynn*, American Telephone & Telegraph Co., New York.

"How to Determine When a Vehicle Should Be Replaced," by *Joel Dean*, Columbia University, New York.

Materials Session: Chairman, *R. W. Roush*, Timken-Detroit Axle Co., Detroit.

"Present Day Approach to the Choice and Application of Automotive Steels," by *W. E. Jominy*, Chrysler Corp., Detroit.

"Applications, Materials, and Specifications of Bolts," by *W. C. Stewart*, American Institute of Bolt, Nut, and Rivet Manufacturers, Cleveland, Ohio.

Monday Afternoon, Transportation & Maintenance Session: Chairman, *W. A. Taussig*, Burlington Truck Lines, Inc., Galesburg, Ohio.

"Factors That Determine the Proper Intervals Between Preventive Maintenance Procedures," by *W. J. Cumming*, White Motor Co., Cleveland.

Body Session: Chairman, *Clarence Kramer*, Ford Motor Co., Dearborn, Mich.

ASA Appoints Vice Admiral Hussey as Administrative Head

Vice Admiral George F. Hussey, Jr., USN (Ret), wartime Chief of the *Navy's Bureau of Ordnance*, joined the staff of the *American Standards Association* and on January 1 assumed the duties as administrative head of that organization. In this capacity Admiral Hussey will continue to serve the nation by directing the cooperative efforts of industry, consumers and government in the vital problem of standardization. *Cyril Ainsworth*, who for a number of years has been in charge of the technical activities of the ASA, will serve with Vice Admiral Hussey as director of operations of the ASA staff.

Vice Admiral George F. Hussey, Jr.

In accepting the appointment, Admiral Hussey will take over the tremendously increased administrative responsibilities from *Dr. P. G. Agnew*, under whose capable direction the ASA has progressed to its present high level. Dr. Agnew, one of the world's foremost authorities on standardization, will continue his service to ASA as Consultant.

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News from California

By Fred A. Herr

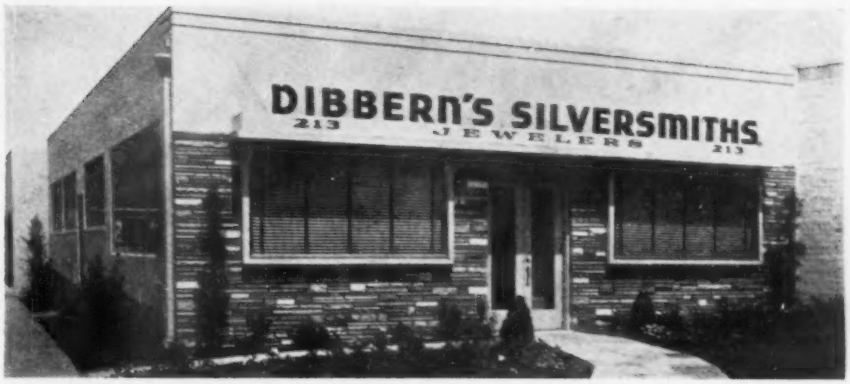
A. H. Dibbern Opens New Plant

The new jewelry display room and precious metal finishing shop opened by *A. H. Dibbern* at 213 South Glendale Blvd., Glendale, Calif., recently reflects the progress that is taking place in Southern California in the field of specialized forms of metal finishing.

Operated under the firm name of *Dibbern's Silversmiths and Jewelers*, the new establishment is comparatively small but ranks as one of the most finely equipped and laid out plants for the repairing, replating and refinishing of old and the design and manufacture of new silverware, rings and miscellaneous items of jewelry.

The plant and building represent an investment of $40,000. The structure is of one-story height and houses a combination display room and factory. The facade is of artistic flagstone arrangement.

The forepart of the building is devoted to a display room which effectively reflects the nature of the business conducted in it.



Exterior view of new $40,000 building of Dibbern's Silversmiths at Glendale, Calif., recently opened for business by A. H. Dibbern.

Rings, in the manufacture of which Dibbern specializes, handwrought Sterling silverware, a wide variety of early American-Victorian, English and American-Sheffield plate, and other silverware and jewelry are displayed in a series of glass topped floor cases and glass-fronted wall cabinets.

The manufacturing, plating and polishing departments occupy the rear half of the building. This area is divided into three rooms—one for plating and cleaning, one for buffing, and one (an acid room) for stripping work.

The plating setup consists of a 150-gallon silver tank, a 65-gallon silver strike tank, a 65-gallon copper tank, a 65-gallon brass solution tank, and two 80-gallon silver solution tanks for use in finishing silver flat ware.

The plant is also equipped with facilities for five different gold solutions: rose, gold, yellow gold, white gold and two other shadings.

An 8 x 16 foot buffing room, walled off from the main plating department, occupies one corner of the building. This room is equipped with two jewelry

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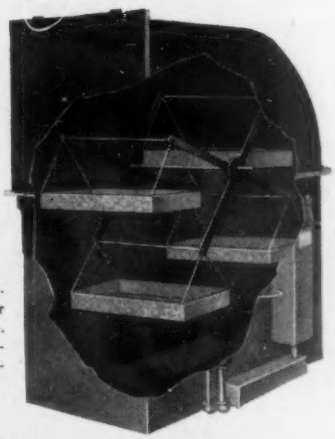

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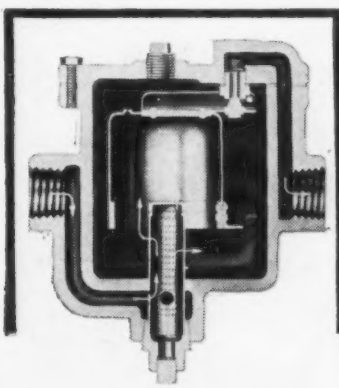

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An interior view of the plating department, note the walled off buffing department. Behind the buffing department is a separate acid room in which stripping, pickling and scratch buffing operations are handled remote from the main plating room.

lathes. The firm does its dry Butler finishing with the jewelry lathes and handles wet Butler work by scratch buffing. The buffing room is equipped with a blower system for effective handling of buffing dust.

The plant also contains an acid room in which stripping, pickling, scratch buffing and similar operations which might pollute the air of the main shop are conducted. The entire building is air conditioned.

Joseph Sunderhaus, past-president of Los Angeles Branch of the American Electroplaters' Society, is general superintendent of plating for the Dibbern Co.

George W. Slomin, formerly chief chemist for the *Stewart-Warner Corp., Chicago*, on December 1 became associated with *Earl Calderon* in the operation of *Calderon Laboratories, Los Angeles*. Slomin, for a number of years, functioned as a free lance consultant chemist, headquartering in Chicago, and operating throughout the middle-west and east coast. He is the inventor of the Slomin electrolytic analyzer for making analyses of metal

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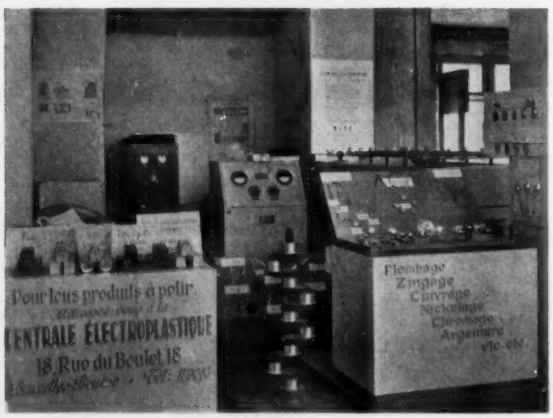

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alloys and plating solutions, which is now manufactured by the *E. H. Sargent Co.* of *Chicago.*

Slomin is serving the Calderon Laboratories in the capacity of trouble shooter for plating shops that require technical assistance in keeping their solutions to operational perfection. Earl Calderon, head of the laboratories, formerly served as analytical and process engineer for the *North American Aviation Co., Inglewood, Calif.*, and is well known for his research work in Beryllium.

The Vacu-Blast Co., Inc., manufacturers of the Vacublaster for the metal finishing industry, is now housed in an attractive new factory and general office building at 320 *Peninsula Avenue, San Mateo, Calif.*, some 15 miles south of San Francisco. The new plant consists of a one-story building, 60 x 80 feet in area, in which some 480 square feet of floor area are available for manufacturing, assembly and administrative purposes. *L. H. Bishop*, president, reports that with the enlarged facilities now at its disposal, the firm has been able to step up production approximately 100% on its new continuous operating Vacublaster, over the output that was possible in the former smaller plant in Burlingame, Calif.

The Russell-Burdsall-Ward Bolt & Nut Co. has announced plans for the erection of a new one-story 80 x 173 foot storage and pickling building for the production of nuts and bolts at 4466 *Worth Street, Los Angeles.*

Articles of incorporation have been issued to the following firms:

Standard Chemical Corp., San Francisco, capital stock $75,000. Directors, *Louis T. Kruger, Myrna Misbach* and *C. Smith*, all of San Francisco.

Calsol, Inc., Los Angeles, incorporated for the purpose of disposing of petroleum, natural, synthetic and other solvents of various kinds. Associated in the enterprise are *Harry A. Faull,*

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Convention Hall

John W. Coffman and *Charles M. Crawford*, all of Pomona, Calif.

A diecast plant installed during the war by *Cannon Electric Manufacturing Co.* of *Los Angeles* as a department in its manufacturing processes for electrical connectors, has been effectively converted to peace-time production.

The firm has digressed from its former policy of making only connectors and high quality electrical specialties and has entered the field of mass-producing low cost items which require die casting as a major stage in the production process. Among the new products being turned out in the die casting department is a line of conduit fittings for building and house wiring. Other new products include a garden sprinkler, pedestal light for driveways, and a series of broilers and grills.

Obituary

SAMUEL L. COLE

It is with deepest regret that we announce the passing of *Mr. Samuel L. Cole*, Executive Vice-President of *Chas. F. L'Hommedieu & Sons Co.*, suddenly on Dec. 16th, 1947.

Samuel L. Cole

Mr. Cole had been with the firm for 25 years, and was well known throughout the industry. He was a member of The Fellowship Club, and also a member of the Toledo Chapter of the A.E.S.

He is survived by his widow, Vienna, and a son, Samuel, Jr.

TECHNICAL LITERATURE

1947 A.S.T.M. Standards on Copper and Copper Alloys

The 1947 edition of the compilation of *A. S. T. M. Standards on Copper and Copper Alloys* which include cast and wrought materials, electrical conductors, and non-ferrous metals used in copper alloys, aggregates 480 pages.

The section on Copper and Copper-Alloy Wire and Cable for Electrical Conductors has 15 specifications for a variety of wire, rods, etc. Following this there are 12 widely used standards covering various non-ferrous metals, such as slab zinc, silicon copper, nickel, lead and others. Then follow sections on the various copper and copper alloy products as follows:

a. Plate, Sheet, and Strip
b. Wire, Rods, Bars and Shapes
c. Pipe and Tubes
d. Alloys for Sand Castings
e. Alloy Die Casting

Finally, there is an extensive section of 140 pages covering methods of tests including the expansion test, mercurous nitrate tests, tension hardness and others. Copies of this book in heavy paper cover may be procured from A. S. T. M. Headquarters, 1916 Race St., Philadelphia 3, Pa., at $4.00 each.

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Letters to the Editor

Finishing Publications, Inc.
11 West 42nd Street
New York 18, N. Y.
Attention: Editor

Gentlemen:

In the November 1947 issue of "Metal Finishing", a problem was presented regarding blistering of plated white metal containing zinc and aluminum.

We have done considerable work in our laboratory in determining a proper sequence of operations for plating this alloy which is relatively difficult to plate. Successful plating involves more than proper cleaning as outlined in your answer.

Practical experience in the plating of slush mold castings commonly referred to as zinc castings has indicated that because of the presence of a fair percentage of aluminum in the alloy, it is often necessary to treat the article as both a zinc and an aluminum casting. It is apparent that when the article is of such thin section as to warrant very constant temperature throughout the metal during the pouring process, the item can be handled in the same manner as a true zinc base die casting containing little or no aluminum. Whenever the casting is of sufficient thickness such that cooling of the molten metal takes place at varying rates throughout the piece, there then is produced an alloy of zinc and aluminum which is high in aluminum. If this alloy is present on the surface to be plated, it is then difficult to get good adhesion of any plate. We find that if the article is treated as a zinc base die casting in the cleaning and acid dipping operations and is then further treated as an aluminum casting prior to the plating operation, a satisfactory and fully adherent plate will be obtained.

We, therefore, recommend the following plating cycle:

1. Remove buffing compounds by means of an emulsion cleaner.
2. Rinse with running water or water spray rinse.
3. Clean with an anodic type zinc cleaner with a concentration of 6 oz./-gal. and operated at 180-200° F. The work should be made the anode with a current density of not more than 20 amp./ft.$_2$. Time, approximately 30-60 seconds.
4. Rinse with running cold water.
5. Immerse for 10-15 seconds in 1% sulphuric or muriatic acid. Shorter immersions in acid concentrations up to 5% can also be used.
6. Rinse with running cold water.
7. Immerse for 3-5 seconds in strong sodium zincate solution containing a small amount of copper,* which solution is a pre-treatment process for plating on aluminum.
8. Rinse with running cold water.
9. Plate in any solution suitable for use on zinc base die castings.

It has been found that if the zincate treatment is not used, good adhesion of the plate will occur over a large percentage of the surface but that those small areas containing the high aluminum-zinc alloy will blister later. This method has been used with those alloys containing 95% zinc and either 5% aluminum or 3% aluminum and 2% copper.

Very truly yours,
ENTHONE, INC.
WALTER R. MEYER,
President.

Editor
Metal Finishing

Regarding the enclosed "*Acid*" ZnCN, could it be that reporters would benefit by a little high school chemistry?

"ACID" Pollution Kills Fish in Kazoo River

Kalamazoo — State stream experts today blamed waste from an industrial plant for a pollution of the Kalamazoo River which has killed thousands of fish in the last 48 hours.

Residents of Kalamazoo and other communities along the river were warned against swimming or eating any of the fish. So far no illness has been reported.

The secretary of the state stream control commission said an investigation showed the fish were killed by a *zinc cyanide waste* dumped into the city sewers by a plating company.

(P. S. *This also got by the Editor! 'Nuff said!*)

Christmas Greetings

Christmas and New Years Greetings were received from the following:

American Brass Co.
American Wheelabrator & Equipment Corp.
Agate Lacquer Manufacturing Co.
Astor-Ramel Manufacturing Co.
Associated Business Counsellors.
American Electroplaters Society—New York Chapter.
Mr. & Mrs. George Black.
Adolph Bregman.
Frederick W. Bogert.
Roy Beaver.
Chemclean Products Corp.
Harry N. Coleman & Co.
Cabbot & Coffman, Inc.
Champion Chrome Plating Co.
The Clinton Co.
Conneaut Plating Industries.
Divine Bros.
Tom Dickinson.
Eaton Chemical & Dyestuff Corp.
Edward W. T. Faint.
Fred Fulforth.
Louis M. Hague.
Mr. & Mrs. George B. Hogaboom
Ernest & Friedl Hinterleitner.
Industrial News Service.
Henry L. Kellner.
Knapp Engraving Co.
C. F. L'Hommedieu & Sons, Co.
Bob & Laura Leather.
Ernest Lamoureux.
C. & S. Linick.
Rick Mansell.
Glenn L. Martin Co.
Marmon-Herrington.
Minden Press.
Mercready & Co.
Novitsky Plating Rack Co.
J. C. Oberender.
Dorothy & Frank Powell.
Patent Button Co.
Phillips Webb Upham & Co.
Puritan Manufacturing Co.
Andrew V. Re.
Reynolds Metal Co.
William R. Shields Co.
Sulfur Products Co.
Catherine & Horace Smith.
Sangamo Electric Co.
Tutrone Printing Co.
O. S. Tyson.
United Chromium, Inc.
Fred W. Vogel.

Our sincere thanks for your kind remembrances. Best wishes and a Happy New Year to all our friends.

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1—300 Ampere, 15 volt, Star.

2—67 Ampere, 15 volt, Continental.

1—750 Ampere, 15 volt, Star.

1—1000 Ampere, 15 volt, General Electric.

1—1000/500 Ampere, 12/24 volt, Hanson-Van Winkle, synchronous, 900 RPM.

1—600 Ampere, 24 volt, Reliance.

2—250 Ampere, 22/26 volt, General Electric.

1—800 Ampere, 22/33 volt, General Electric.

1—134 Ampere, 24 volt, Westinghouse.

2—1600 Ampere, 30 volt, General Electric.

2—800 Ampere, 30 volt, General Electric.

1—205 Ampere, 32 volt, General Electric.

1—1200 Ampere, 32½ volt, General Electric.

1—1000 Ampere, 33 volt, General Electric.

1—205 Ampere, 42 volt, General Electric.

1—75 Ampere, 50 volt, General Electric.

2—800 Ampere, 50 volt, General Electric.

1—400 Ampere, 60 volt, General Electric.

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